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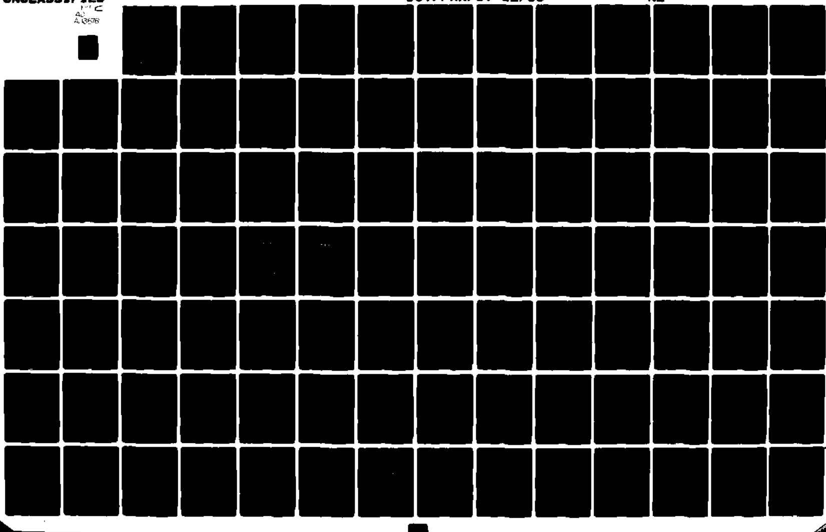

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The Effects of Pilot Experience On Acquiring Instrument Flight Skills - Phase II

Embry-Riddle Aeronautical University
Regional Airport, Daytona Beach, FL 32014

March 1982

Final Report

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16. Abstract

Because of the relatively high involvement of low-time noninstrument rated general aviation pilots in fatal weather-related accidents, a study was undertaken by the FAA through a contract with Embry-Riddle Aeronautical University (E-RAU) to determine the relationship between total flight time and the ability to acquire instrument flying skills. Specifically, the study examined the feasibility of reducing the present 200-hour experience requirement (FAR 61.65) for an instrument rating. The results of the study indicated that a reduction in the 200-hour requirement should be considered. The study reported here extended the findings of that study to a more heterogeneous population, aircraft of greater complexity, and a training program conducted in a non-institutional setting. Thirty-five low-time pilots of diverse ages and occupations completed an instrument training program conducted at the FAA Technical Center. Cessna 172 and Mooney M20 aircraft were used in training. No significant differences could be found among the subjects of the present study which related to aircraft complexity. Objective measurements of performance of the subjects in the present study revealed significant differences when compared with the earlier study, with the present study subjects demonstrating higher error rates. However, all students demonstrated competency by passing an FAA practical flight test, administered by an FAA examiner.

The results of this study support those of the earlier study and extend them to a different population. The results indicate that consideration should be given to reducing the 200-hour experience requirement.

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METRIC CONVERSION FACTORS

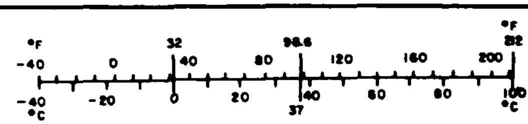
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

This report describes the second phase of an investigation of the effects of pilot experience, as defined by total flight time, upon the acquisition of instrument flying proficiency. It has been noted that low-time, noninstrument rated pilots have a relatively high rate of involvement in fatal weather-related accidents because they inadvertently encounter weather conditions in which they are not prepared to fly. As a result, there has developed a general concern that the current 200-hour experience requirement for the instrument rating (FAR 61.65) may postpone unnecessarily the commencement of instrument training until pilots have obtained approximately 150 hours of flight time. Thus, a question has arisen as to the feasibility of reducing the 200-hour experience requirement with the objective of decreasing the incidence of weather-related accidents among low-time pilots. In order to assess this feasibility, an experiment (designated Phase I) was carried out at Embry-Riddle Aeronautical University (E-RAU) to examine the relationship of total flight time to the ability of pilots to acquire instrument flight skills. During the study, three experimental groups received standard instrument training after 67, 100, and 130 hours of total flight experience. The results of the study suggest that total flight time, within the range examined, had no significant effect on the level of instrument flying proficiency achieved. However, there were limitations to the study in that (1) the population from which the sample was drawn was relatively homogeneous since it was made up of college students, (2) only one type of aircraft (the Cessna 172) was used in the study, and (3) the instrument training program was conducted in an institutional setting. Details of the Phase I experiment are contained in a separate report (Childs, Prophet, and Spears, 1981). The purpose of the present effort (designated Phase II) was to overcome these limitations and extend the findings of the Phase I study to a more heterogeneous population, aircraft of greater complexity, and a training program conducted in a noninstitutional setting.

This study was conducted by The Aviation Research Center of E-RAU and Seville Research Corporation, under contract to the Federal Aviation Technical Center. The activities of Seville Research were conducted under subcontract to E-RAU, the prime contractor.

Dr. Charles W. Holmes, Senior Research Scientist for The Aviation Research Center of E-RAU, was Project Manager and Principal Investigator for the task. The Project Director for the Seville Research Corporation was Dr. Jerry M. Childs. The Contracting Officer's Technical Representative (COTR) was Douglas P. Harvey.

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EXECUTIVE SUMMARY

National Transportation Safety Board (NTSB) data indicate that a disproportionate number of weather-related accidents has involved pilots who (1) had fewer than 200 hours total flying time, (2) had little or no instrument training, and/or (3) were not instrument rated. This relatively high rate of involvement in weather-related accidents could result from the mismatch between pilot capabilities and task demands when low-time pilots find themselves, either deliberately or inadvertently, in instrument meteorological conditions. It is such encounters that often result in "continued VFR operations in IFR conditions" as a causal or contributing factor to such accidents. As a consequence, there is a growing concern that a training problem exists relative to current Federal Aviation Administration (FAA) instrument rating requirements. Because of these concerns, there have been calls for general reassessment of these requirements and, specifically, a reduction in the total time requirement for the instrument rating.

In response to these calls, an experiment was carried out at Embry-Riddle Aeronautical University (E-RAU) to examine the relationship of total flight time to the ability of pilots to acquire instrument flight skills. During that study (designated Phase I), three experimental groups received standard instrument training after 67, 100, and 130 hours of total flight experience. A fourth group was selected from the "normal" training track at E-RAU to provide experimental control. All subjects were administered a standardized instrument checkride following their instrument training. The results of the study suggested that total flight time, within the range examined, had no significant effect with regard to the level of instrument flying proficiency achieved. However, there were limitations to the study in that (1) the population from which the sample was drawn was relatively homogeneous since it was made up of college students, (2) only one type of aircraft (the Cessna 172) was used in the study, and (3) the instrument training program was conducted in an institutional setting.

In order to overcome these limitations, a Phase II study was conducted in which two groups of subjects from a different population underwent an instrument training program and subsequent flight evaluation in a noninstitutional setting. One group received their flight training in a relatively simple aircraft (Cessna 172), and the other group received their flight training in a representative, complex aircraft (Mooney M20C).

OBJECTIVES.

The experiment reported here had two primary objectives. The first was to compare the performance of the group flying the Cessna aircraft with the performance of the two low-time groups in the Phase I study. The second objective was to compare the performance of the subjects flying the Cessna aircraft with the performance of the subjects flying the Mooney aircraft.

METHOD.

The experiment was carried out at the FAA Technical Center, Atlantic City Airport, New Jersey, using FAA Technical Center facilities. The two experimental groups (Cessna group and Mooney group) were composed of FAA volunteers. At the time of selection, the subjects had between 50 and 110 hours total flight time. The ages of the subjects ranged from the early 20s to the mid 50s. All of the subjects had private pilot licenses and had fewer than ten hours of instrument flight instruction.

The subjects underwent three phases of training. First, all subjects completed a structured instrument ground school of 48 hours duration conducted over a period of approximately two months. Next, all subjects completed a transition flight period of no more than ten hours to ensure contact flight proficiency. Finally, all subjects completed an instrument flight training program consisting of approximately 14 hours simulator time and 40 hours flying time. All subjects were administered a standardized instrument checkride at the completion of instrument training, in addition to the FAA practical flight test. A total of 44 subjects began the program by taking the instrument ground school. Thirty-seven subjects were selected for the instrument flight training. Of these, 35 subjects completed the program.

With the exception of the different aircraft used in instrument training, the content and sequence of the training program were standard. The experimental approach called for three sets of data: (1) measures of flight proficiency on a contact checkride administered prior to instrument training; (2) daily progress measures administered during instrument training; and (3) measures of flight proficiency on the instrument checkride administered upon completion of instrument training. Objective, inflight, data collection forms known as Pilot Performance Description Records (PPDR) were used to gather these data.

In addition to the objective measures of flight proficiency, provision was made for checkpilots to assign, on a subjective basis, a letter grade to the performance of each maneuver by each student on both contact and instrument checkrides. Letter grades also were assigned to each of four "flight quality" dimensions describing overall checkride performance.

All checkrides were administered by the site manager or the chief instructor pilot. The FAA practical instrument test was administered to all subjects by the FAA designated examiner assigned to the FAA Technical Center.

RESULTS.

Analyses of variance performed on contact checkride performance data revealed no statistically significant differences between the Cessna and Mooney groups. This finding supported the hypothesis that any instrument flight proficiency differences between the groups in the Phase II study would be a function of the treatment (i.e., simple vs complex aircraft) rather than initial flight skill differences. The differences between the error rates of the group to be trained in the Cessna and the Phase I A and B groups were statistically significant. These differences indicated that the Phase II Cessna group was somewhat less proficient than the Phase I groups, as measured by PPDR error rates, at entry into instrument training.

Analysis of the instrument error rate scores revealed no statistically significant differences between the Cessna and Mooney aircraft groups. Percent error differences between the Cessna group and the Phase I groups were significant beyond the .001 level, with the Cessna group producing the higher error rates. It should be noted that the effect resulted mainly from error rate differences on maneuvers performed infrequently (e.g., magnetic compass turns, radar vectors, and unusual attitude recoveries), as opposed to such commonly performed maneuvers as instrument approaches (e.g., VOR and ILS). It is possible that these differences reflect differences in training emphasis, as well as variations in population and training setting.

Analysis of daily training performance indicated that both groups of Phase II improved significantly over time. In addition, the nature of the performance change was virtually the same for both groups. Since analysis of daily training performance data was not made during the Phase I study, no comparisons were made between the Cessna group and the Phase I groups.

Perhaps the measure of greatest significance is the ability of the subjects to pass the FAA practical flight test following their instrument training programs. In the Phase II study, all of the students who completed the training program passed their instrument flight checkride administered by an independent FAA examiner. Hence, at the completion of their training program all students met (or exceeded) FAA instrument checkride standards.

DISCUSSION.

This study comprised the second phase of an empirical effort to determine the effects of prior flight time upon the ability to acquire and demonstrate instrument flight skills. Results of the Phase I study indicated that the amount of pre-instrument training time, within the range investigated, did not affect instrument flight skill learning.

Results of the present study support those of Phase I and extend them to an older, more heterogeneous subject population trained in a noninstitutional setting. On the basis of these findings, the amount of total prior flight time (within the 100-200 hour range) does not appear to be a valid indicator of student ability to acquire instrument flying proficiency. While Phase II objective instrument error rates were higher overall than those of comparably experienced groups in Phase I, the outcome of instrument training in both instances was a demonstration of instrument proficiency commensurate with FAA flight check standards. The greater instrument error rates in Phase II conceivably resulted from subject age and vocational factors, as well as possible inflight recording variations due to involvement of different checkpilots in the two phases.

The more complex aircraft had almost no influence on students' instrument learning ability as shown by both objective and subjective grades on the instrument checkride.

CONCLUSIONS.

1. Phase I and Phase II subject populations differed significantly in their ability to demonstrate the flight skills that are assessed by the objective performance measures. This was shown by the significantly higher error rates produced by Phase II students as compared to the aeronautical university students of Phase I. In both phases, however, subjects exhibited the degree of skill required to pass the FAA practical instrument flight test.

2. The relative complexity of the aircraft in which instrument training was conducted had no discernible effects upon instrument flying skill acquisition.

3. For the subject populations, degree of aircraft complexity, and training settings investigated, amount of total flight time had no influence on students' ability to acquire the skills necessary to pass the FAA practical instrument flight test.

INTRODUCTION

This study represents the second phase of an empirical examination of the relationship between pilot experience, defined by total flight hours, and the ability to acquire and demonstrate instrument flight skills.

During the next decade, the relative impact of general aviation as a segment of the nation's aviation activity is projected to increase rather dramatically. For example, numbers of general aviation aircraft and pilots are expected to rise 44% and 25% respectively by 1992 (FAA, 1980). Partly because of a requirement for cost effective and flexible business use of aircraft, and also due to ongoing advancements in avionics technology, the number of general aviation instrument operations is also expected to increase by approximately 35% over the same period. The safety record of general aviation is of concern during this growth period. An examination of historical trends in accident data suggests that improvements to aviation equipment, while desirable in many respects, do not seem to effect appreciable improvements in the general aviation accident record. Rather, equipment characteristics must be viewed as one of many interactive system variables that influence the capabilities and skills of general aviation pilots to respond safely and reliably to diverse and often complex task demands.

This study addresses two of the factors that appear as causes of, or contributors to, general aviation accidents. One of the factors relates to the pilot (experience level); the other relates to task conditions (adverse weather). In order to provide background information for this study, there follows a brief discussion of general aviation weather-related accident data, with emphasis upon the experience acquired by the pilots involved in those accidents. The purpose of the discussion is to explore various aspects of the interaction between pilot experience and weather-related accidents, and to suggest that accidents attributed to their interaction could be reduced by straightforward revisions to current instrument training practices.

BACKGROUND.

National Transportation Safety Board (NTSB) data, while limited in certain respects, may be employed to identify critical trends in factors affecting general aviation accidents. Such data indicate that the flying period between attainment of the private license and the instrument rating is hazardous from the standpoint of the pilot's ability to operate under instrument

meteorological conditions (IMC). Furthermore, the FAA has found that "weather is the most frequently cited causal factor in fatal, general aviation accidents and has been for several decades" (NTSB, 1974, p. 1). For example, during the ten-year period ending in 1978, weather-related accidents resulted in an average of 642 fatalities per year (NTSB, 1980). Exact determinations of the extent to which pilots involved in those accidents were (or were not) qualified and competent to operate under IMC are problematic due to a lack of relevant data. However, during the period 1964-1972, 74% of the pilots involved in fatal weather-related accidents were not instrument rated, (NTSB, 1974, p. 12). In addition, the number of fatal and nonfatal accidents occurring during a nine year period (1964-1972) was found to be significantly lower ($p < .05$) for those pilots who had 20 or more hours of actual instrument time compared to those who did not (NTSB; 1974; 1976). Finally, of the more than 5,200 nonfatal weather-related accidents occurring during the 1964-1974 time interval, 83% involved pilots with fewer than 100 hours of total flight time. These statistics indicate generally that the interaction between low pilot experience levels and adverse weather conditions may increase inordinately the probability that general aviation accidents will occur. Specifically, they suggest that likelihood of accident involvement for novice non-instrument rated pilots who operate their aircraft under visual flight rules (VFR) in instrument meteorological conditions exceeds chance levels. The problem can be viewed from a systems perspective by recognizing that a mismatch between pilot capabilities and task demands exists when pilots who lack requisite instrument flying experience and/or skills find themselves in instrument meteorological conditions. One way to address this operational problem is from a training standpoint. Specifically, if it were feasible to train requisite instrument flight skills earlier in the training process, fewer weather-related accidents might result.

There exists, however, a regulatory obstacle for the conduct of such instrument flight training. Instrument ratings cannot be issued to private pilots who have accumulated less than 200 hours of total flight time as specified in Federal Aviation Regulation (FAR) 61.65. While this experience requirement would, upon initial consideration, appear to be beneficial from a safety standpoint, it appears to have inhibited pilots from commencing instrument training before they have acquired approximately 150 hours of total time.[1]

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[1] One apparent reason for this practice is cost effectiveness. Assuming 40-50 hours of instrument training, the private pilot who initiates such training with approximately 150 total flight hours will have acquired the necessary 200 total hours of flight time at the point of the instrument checkride, thereby alleviating "excess" flying hours (and attendant costs).

While the exact genesis of the 200 hour requirement for the instrument rating is not presently known, it can be safely stated that its designation was not based upon empirical performance data. Indeed, there have been numerous calls for a reduction in the requirement. One such recommendation to that effect was from the First General Aviation Safety Workshop held at the Ohio State University (Lawton and Livack, 1979).

While there are no known directly relevant studies bearing on the effects of total flight time upon the facility of students to acquire and demonstrate instrument flight skills, there have been several studies designed to teach instrument cues early in the training process and to determine the effects of such training upon student pilot performance. Such studies have shown that students having undergone instrument training either before, or in conjunction with, contact training demonstrate proficiency levels equal to or greater than those of students who have undergone the more traditional contact-followed-by-instrument sequence (e.g., Ritchie and Michael, 1955; Williams, Houston and Wilkerson, 1956; Seltzer, 1958; Ritchie and Hanes, 1964; Easter and Hubbard, 1968; Prophet and Jolley, 1969). The reader is referred to Appendix A for a more detailed discussion of this type of training, much of which has been collectively referred to as "integrated training." It is also noted that all branches of military aviation have, for many years, exposed flight students to instrument cues very early in the training process.

The above studies, together with instrument training curricular analyses and recent calls for a reduction in the total time requirement, served as the overall impetus for the present study. As earlier noted, the current effort comprised Phase II of the study. A brief discussion of Phase I objectives, methods, and findings follows.

INSTRUMENT TRAINING STUDY, PHASE I (Childs, et al., 1981). The calls for a reduction in the 200-hour requirement raised a practical and valid question about the advisability of such a move. Since no empirical data existed upon which a decision to reduce the requirement could be based, an experiment was conducted to gather information relative to this question.

The experiment was carried out jointly by Embry-Riddle Aeronautical University (E-RAU), Daytona Beach, Florida, and the Seville Research Corporation, Pensacola, Florida. The effort was sponsored by the Federal Aviation Administration (FAA) Technical Center and the FAA Office of Systems Engineering Management, and was monitored by the FAA Office of Flight Operations.

Objectives of the Phase I Study. The primary objective of the experiment was to examine the relationship of total flight time to the acquisition of instrument flight skills, as demonstrated by performance on an instrument checkride. Secondary objectives were to (1) identify and assess specific instrument maneuver performance differences by student pilots whose total flight times ranged between 100 and 200 hours, and (2) determine whether differences in total flight time affected the general process by which daily instrument flying skills were learned.

Method. The experiment was carried out utilizing E-RAU students and training facilities. Three experimental training groups (A, B, and C) were constituted from E-RAU student volunteers. Each group received standard instrument training after varying amounts of total contact flight experience. Group A began its instrument training after 67 hours, Group B after 100 hours, and Group C after 130 hours of total contact flight time. Each group was then administered a standardized instrument checkride after completion of their instrument training. A total of 96 subjects, all without any previous flight experience, began the program. Of these, 79 subjects completed instrument training (27 in Group A, 26 in Group B, and 26 in Group C). The performances of the subjects in the experimental groups were compared with that of the subjects in a fourth group, who underwent the normal training track at E-RAU.

Because the study was intended to address factors pertaining only to experience as defined by number of flight hours, the content and sequence of training for experimental groups were controlled to the greatest possible extent. The content and sequence of instrument training were standard across groups. The experimental approach called for three sets of data for each group: (1) measures of flight proficiency on a contact checkride administered prior to instrument training; (2) daily progress measures administered during instrument training; and (3) measures of flight proficiency on an instrument checkride administered upon completion of instrument training. Objective, inflight data collection forms were developed and used to gather these data.

The contact and instrument checkrides each yielded two types of measures for analysis. First, adequacy of performance was represented objectively in terms of a percent error score. That is, for all maneuvers scored during a given checkride, the number of maneuver components for which performance was out of tolerance was divided by the total number of scored components and multiplied by 100. Second, provision was made for checkpilots to assign, on a subjective basis, a letter grade to the performance of each maneuver by each student on both contact and instrument checkrides. Letter grades also were assigned to each of four "flight quality" dimensions describing overall checkride performance.

The checkpilots underwent a training program in order to standardize their data collection procedures. Eight checkpilots and 13 instructors were involved in the collection of the data. All data were collected during flights of Cessna 172 aircraft in the E-RAU fleet.

Results. Analyses of variance performed on contact checkride performance revealed no statistically significant differences among the groups with regard to either objective or subjective measures. This finding supported the hypothesis that any proficiency differences among groups on the instrument checkride would be a function of the experimental treatment (i.e., training time) rather than initial flight skill differences.

Analysis of the objective instrument error rate scores, the data of primary interest in the study, indicated that differences among the three groups were not statistically significant. Such differences as did occur in these error rates favored the two lower time groups (A and B) over the group (C) with the greatest amount of total flight time. One-way analyses of variance for the mean instrument checkride letter grades and flight quality grades resulted in statistically significant differences among groups on both measures. However, these differences were consistent with the objective error rates, in that Group C received poorer maneuver and flight quality grades than Groups A and B. These findings clearly support the interpretation that lesser amounts of prior flight time had no adverse effects on instrument checkride performance.

Meaningful analyses of daily training performance data could not be made because the data often were neither comparable across students, nor from day to day for a given student. Since training was individualized to allow each student to reach proficiency, the amount of instrument training given could vary. As a consequence, significant differences were found for the amount of time given during instrument training, with Group A receiving more instrument training time than Groups B or C. Group B received the least amount of training time.

Conclusions. The results of the experiment suggested that total flight time, within the range examined, had no significant effect on objectively measured error rates of instrument flying proficiency. Such significant differences that did result were on subjective measures and favored the lower time groups. The conclusion was therefore made that total flying time, within the range studied, should not be considered a primary criterion in qualifying for an instrument rating. This conclusion was also supported by post-study discussions with the checkpilots and instructors of the experiment, and by review of the research literature on instrument and contact flying.

The Phase I report contained the following specific conclusions:

1. Within the ranges of pre-instrument flight experience examined in this study and for the subject population used, the amount of prior flight time had no effect on the acquisition and demonstration of instrument flight proficiency.

2. Consideration should be given to extending the results of this study to other populations and to reducing the present 200-hour experience requirement for issuance of an instrument rating as a means of encouraging earlier training of instrument skills.

Limitations. The study had certain limitations concerning the applicability of its findings to the rulemaking process. First, the population from which the sample was drawn was relatively homogeneous in that it was made up of college students. The average age of the subjects was 20.6 years, with the maximum and minimum ages being 27 years and 19 years, respectively. Second, only one type of aircraft (the Cessna 172) was used in the study. Since this type aircraft is considered to be relatively simple to operate, no conclusion could be made about how well the low-time students could learn to fly instruments in more complex aircraft. Finally, the instrument training program was fairly concentrated, and was conducted in an institutional setting. This type of program may not correspond with similar programs offered by fixed-based operators throughout the country.

PURPOSE.

The Phase II research effort had two major purposes, both of which were related to the limitations of the Phase I study. First, the study provides additional data for FAA use in rulemaking decisions. Conclusions of the study will provide a basis upon which a decision may be made whether to decrease the 200-hour requirement or to retain the requirement in its present form. Second, the present study extends the findings of the Phase I instrument training study to the following:

1. A population that is more representative of the general aviation community with respect to age and vocation;

2. A representative complex, single-engine general aviation aircraft; and

3. An instrument training program conducted in a noninstitutional setting.

RESEARCH OBJECTIVES.

In order to overcome the limitations of the Phase I study, two groups of subjects underwent an instrument training program and subsequent flight evaluation. The program was conducted by E-RAU at the FAA Technical Center, Atlantic City Airport, New Jersey. One group received their flight training in a relatively simple aircraft (Cessna 172), and the other group received their flight training in a complex aircraft (Mooney M20C). All of the subjects underwent a common instrument ground school.

The specific objectives of the research were:

1. To compare the performance of the group flying the simple aircraft in the present study with the performance of the two low-time groups (A and B) in the Phase I study; and

2. To compare the performance of the subjects flying the simple aircraft with the performance of the subjects flying the complex aircraft.

METHOD

EXPERIMENTAL SETTING.

The study was conducted using volunteers at the FAA Technical Center as subjects. Training required for the experiment was administered by the Aviation Research Center of E-RAU in facilities furnished at the Technical Center. The syllabi used in instrument training at E-RAU, with slight modification to meet the requirements of this study, provided the basis for the training. The subjects underwent three phases of training. First, all subjects completed a structured instrument ground school of 48 hours duration conducted over a period of approximately two months. Next, all subjects completed a transition flight period of no more than ten hours to ensure contact flight proficiency. Finally, all subjects completed an instrument flight training program consisting of approximately 14 hours simulator time and 40 hours flying time. Aircraft used in flight training were furnished by the Aviation Research Center.

The FAA granted an exemption from the current instrument pilot experience requirements to allow the subjects to receive their instrument ratings after successfully completing the experimental training, and passing the written and practical tests required by section 61.65 of the FAR. The exemption (Appendix B) restricts the operation of aircraft under instrument flight rules by the subjects to United States airspace until current minimum flight hour requirements for an instrument rating are met.

EXPERIMENTAL APPROACH.

The major purpose of this study was to determine whether the findings relative to the two low-time groups of Phase I would hold true for a different student pilot population and more complex aircraft. In order to achieve this purpose, an experimental approach was used in which data were collected on two groups of subjects, each having diverse ages and vocations. One group received instrument flight training in the Cessna 172 aircraft, and the other group received training in the Mooney M20C. The Mooney, having retractable landing gear and a constant speed propeller, met the criteria established by the FAA for a complex general aviation aircraft.

The performance of the subjects receiving training in the Cessna aircraft was compared with the performance of the two low-time groups in the Phase I study. The purpose of this comparison of Phase I and Phase II subjects was to determine whether any differences in acquiring instrument flight skills were related to

population differences. Performance of the two groups of Phase II subjects was then compared to determine whether there were any differences in acquiring instrument flight skills as related to aircraft complexity. Data were collected to address nine dependent measures, which may be grouped in the following five categories:

1. Measures of flight proficiency on a contact checkride;

2. Daily progress evaluations during instrument training;

3. Measures of flight proficiency on an instrument checkride;

4. Training hours flown during instrument training; and

5. Pass/Fail of the practical flight test required by Section 61.65 of the FARs.

The nature of these measures and the procedures for obtaining them are described later. The primary statistical tests used in comparing means and standard deviations were one-way analyses of variance (ANOVA), and t tests. A brief description of the statistical procedures used during the analysis is contained in Appendix C.

SUBJECTS.

All subjects participated in the experiment on a voluntary basis. Subject selection was the responsibility of a committee chaired by the FAA Contracting Officer's Technical Representative (COTR). Only those individuals possessing a valid private pilot certificate and having between 50 and 110 total flight hours were eligible to volunteer.

A total of 44 subjects attended the instrument ground school. Following the ground school, thirty of the subjects were selected to receive flight training, with the remaining subjects being designated as alternates. Prior to the start of flight training, seven additional subjects were selected from the alternates, increasing the sample size to 37. The purpose of the additional subject selection was to allow for possible attrition, thereby providing for a minimum sample size of 30 subjects at the end of the experiment. Only two subjects failed to complete the experiment, however. One subject had to terminate for medical reasons, and the other had to terminate for job reasons.

The professional composition of the sample of the 35 subjects remaining at the end of the experiment was as follows:

1. Engineer - 21

2. Specialist/Technical - 8

3. Administrative/Secretary - 4

4. Mathematician - 1

5. Lawyer - 1

The final sample consisted of 31 males and four females. The mean age of the subjects was 36.77 years; the mean flying time at selection was 83.49 hours. Complete background data for the subjects are contained in Appendix D.

EXPERIMENTAL GROUPS.

The subjects were assigned to one of two groups in order to accomplish the objectives of the experiment. One group received all instrument flight training and checkrides in the Cessna 172, and the other group received all instrument flight training and checkrides in the relatively complex Mooney M20C. Assignment of the subjects to groups was done on a stratified random basis, since it was desirable that each group be representative of the private pilot age distribution. Table 1 shows the relative number of private pilots in four age groups as a percentage of all private pilots of ages 20-59 (all age 20-59 private pilots = 100%).[1]

TABLE 1. NATIONAL AGE DISTRIBUTION OF PRIVATE PILOTS (AGES 20-59) IN 1979

Age	20-29	30-39	40-49	50-59
Percent by Age Group	26	32	23	19

Source: 1980 U.S. Civil Airman Statistics
U.S. Department of Transportation (FAA, 1981)

[1] Only those pilots in ages 20-59 are shown because this was the age range of subjects available for the present study.

The subjects were divided into four age groups based upon the distribution in Table 1. The resulting sample distribution by age is shown in Table 2.

TABLE 2. SAMPLE DISTRIBUTION OF SUBJECTS BY AGE GROUPS

Age	20-29	30-39	40-49	50-59
Number of Subjects	10	14	6	7
Percent of Sample	27	38	19	16

The data in Table 1 and Table 2 are combined and presented in graphic form in Figure 1. It can be seen that by percentage, the age distribution of the sample closely approximates that of the population.

The subjects were then randomly assigned from each of the age groups to one of the experimental groups. The extra subject from the 50-59 year age group (the only age group with an odd number of subjects) was assigned to the Cessna group. No preference was given to any subject who wanted to fly the Mooney aircraft. However, three subjects were assigned to the Cessna group for reasonable cause after their request for such assignment. One subject, because of his size, could not fit comfortably into the Mooney. One of the older subjects requested assignment to the Cessna group because he was apprehensive of the perceived higher performance of the Mooney.

A third subject was assigned to the Cessna group because of personal desires. The final aircraft-by-age group distribution at the start of flight training is shown in Table 3.

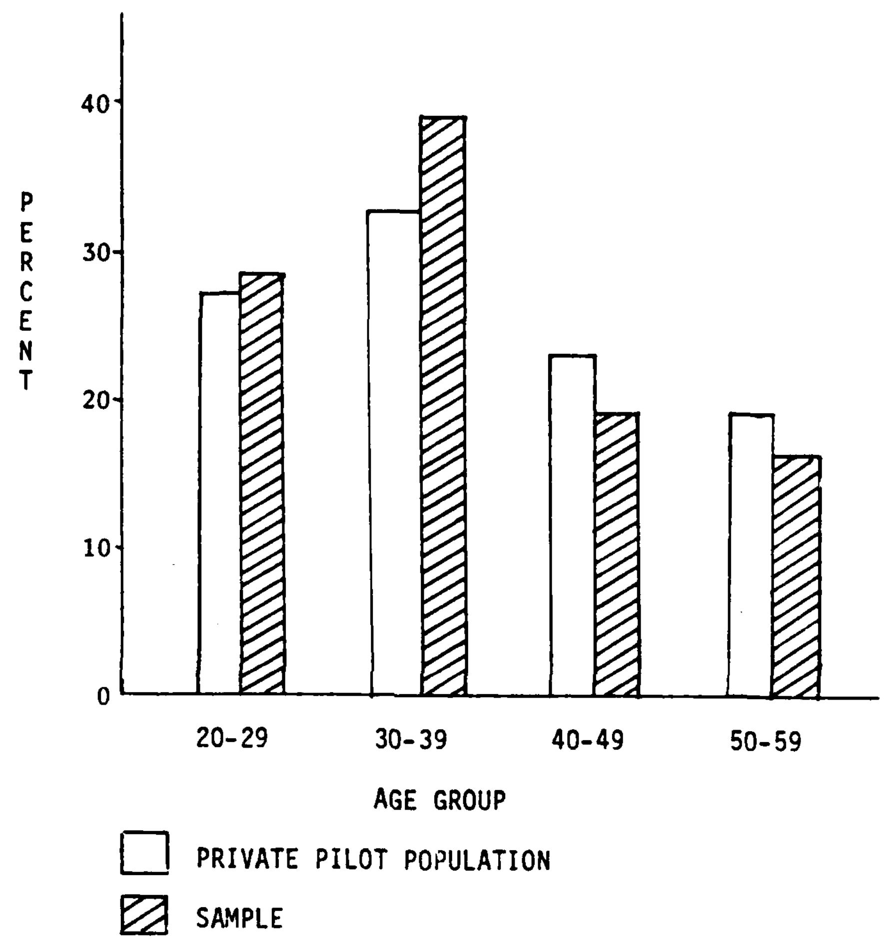


FIGURE 1. COMPARISON OF POPULATION AND SAMPLE AGE GROUP DISTRIBUTION

TABLE 3. SAMPLE DISTRIBUTION BY AGE GROUP AND AIRCRAFT

Group	20-29	30-39	40-49	50-59	TOTAL
Mooney (no. of subjects)	5	7	3	2	17
Cessna (no. of subjects)	5	7	3	5	20

Descriptive statistics for the composition, ages, and entry flying time of the groups in both the Phase I and Phase II studies are contained in Table 4.

TABLE 4. DESCRIPTIVE DATA FOR SUBJECTS WHO COMPLETED THE EXPERIMENT

	NUMBER OF SUBJECTS			AGE		FLYING TIME (ENTRY)	
GROUP	MALE	FEMALE	TOTAL	M[1]	SD[1]	M	SD
Phase I							
Group A	24	3	27	20.93	2.89	67.0	0
Group B	23	3	26	20.15	1.43	100.0	0
Phase II							
Cessna	16	2	18	37.61	10.12	85.42	16.98
Mooney	15	2	17	35.88	9.16	93.65	14.42

[1] M and SD represent the mean and standard deviation. Information pertaining to these statistical terms is contained in Appendix C.

Only subjects who completed instrument training are included in Table 4. The flying times of the A and B groups in the Phase I study were controlled at 67 and 100 hours respectively, with no variability (SD) within the groups. The entry flying time for the Phase II groups includes times completed during transition training. Complete background data for the subjects are contained in Appendix D.

INSTRUCTORS.

Six certificated instrument flight instructors and a site manager, all of whom were employees of E-RAU, participated in the instrument training portion of the experiment. The site manager was also a highly qualified, certificated instrument flight and ground school instructor. One of the flight instructors served as chief instructor pilot. Five instructors trained seven students each, while the chief instructor trained two students. The instrument ground school was conducted by the site manager and the chief instructor. Background data for the instructors are contained in Appendix E.

INSTRUMENT GROUND SCHOOL.

All subjects attended a structured instrument ground school of 48 hours duration. Instruction pertaining to all areas of aeronautical knowledge required by Section 61.65 of the FARs was provided during the course. The primary text for the course was The Instrument Rating (Pan American Navigation Service, 1979). In addition, the following were used as texts and reference materials:

1. Instrument Flying Handbook (FAA, 1968);

2. The Instrument Flight Manual (Kershner, 1977);

3. Instrument Rating Written Test Guide (FAA, 1977);

4. Airman's Information Manual (Aero Publishers, 1981); and

5. Federal Aviation Regulations (Pan American Navigation Service, 1981)

The course was conducted in two sections composed of 22 students each. Each section met twice weekly, each meeting lasting for three hours. All students were administered the FAA written instrument examination on May 4, 1981.

All but one of the subjects satisfactorily completed the ground school phase of the experiment. This subject failed to pass the FAA written examination after two attempts. However, he was retained in the flight program for data collection purposes.

The Phase II subjects completed the FAA written examination with a mean score of 86.17 and a standard deviation of 9.21.

Complete results for the written examination are contained in Appendix F.

TRANSITION FLIGHT TRAINING.

All students next underwent a period of contact flight training to ensure currency, review private pilot standards, and be introduced to the concepts and operation of complex aircraft. A maximum of ten hours flight time was allowed, with a maximum of five hours in each type aircraft. Each student was provided training in both aircraft.

There was no "passing" or "failing" of maneuvers during the transition period. However, the procedures and maneuvers accomplished during each lesson were recorded, and space was provided on the lesson sheet for the instructor to make remarks pertaining to the student's progress, interest, and performance. The instructor and the student determined which maneuvers were to be reviewed on each lesson, and the extent to which individual maneuvers were to be practiced. The maneuvers included in the transition training (Appendix G) are representative of the basic contact flight skills.

INSTRUMENT FLIGHT TRAINING.

The instrument flight program (Appendix H) consisted of 28 lessons structured into three phases of training. The three phases of the training program were comprised of (1) basic attitude instrument flying and radio navigation, (2) instrument approach and terminal procedures, and (3) cross country and final course review. The first lesson was an orientation period during which student/instructor relationships were established and course materials were provided the student. In addition, the student was briefed on course objectives, the training schedule, and record keeping procedures. The remaining lessons consisted of seven sessions using a desktop simulator and 20 dual training flights. The students remained with the same instructor throughout the training program.

During daily training, all required maneuvers were graded as either "satisfactory" or "unsatisfactory". However, all course objectives were completed to a satisfactory level. It was the responsibility of the instructor to determine whether additional practice was required in a specific training area. Additional flight training, when required, was approved by the site manager.

Two subjects, both of whom were in the Cessna group, did not complete the flight training program. One was forced to drop because of a job change; the other was forced to terminate for medical reasons. The remaining 35 subjects (one of whom was not eligible for the FAA flight check) completed instrument training. The subject who was not eligible for the FAA flight check did not pass the FAA written examination.

Figure 2 contains a graphic comparison of training program hours between the Cessna and Mooney groups. "Training program hours" is defined as the total combined simulator and aircraft time flown during instrument training. The figure does not include the transition time flown by the Phase II subjects. The histogram shows the percentages of each group which had total training program times of 30-39 hours, 40-49 hours, 50-59 hours, and 60-69 hours. None of the Mooney group had less than 40 hours. Also, a larger percentage of the Mooney group was in the 50-59 hour range, compared with the Cessna group.

Figure 3 contains similar comparisons between the Cessna group and the Phase I subjects. None of the Phase I A and B subjects was in the 60-69 hour range. However, one of the subjects had over 70 hours, and two subjects had less than thirty. Since there were no comparable times among the Phase II subjects, these three Phase I subjects are not included in Figure 3.

Descriptive statistics for training program and exit hours are summarized for both phases in Table 5. Complete training data are shown in Appendix F.

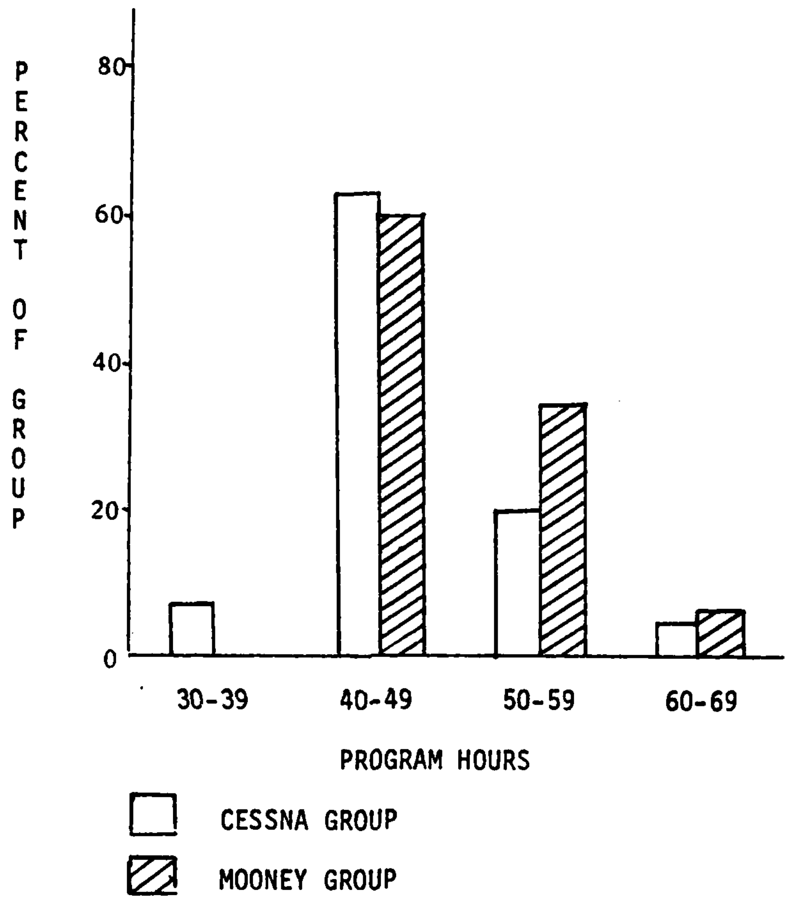


FIGURE 2. COMPARISON OF PROGRAM HOURS BETWEEN CESSNA AND MOONEY GROUPS

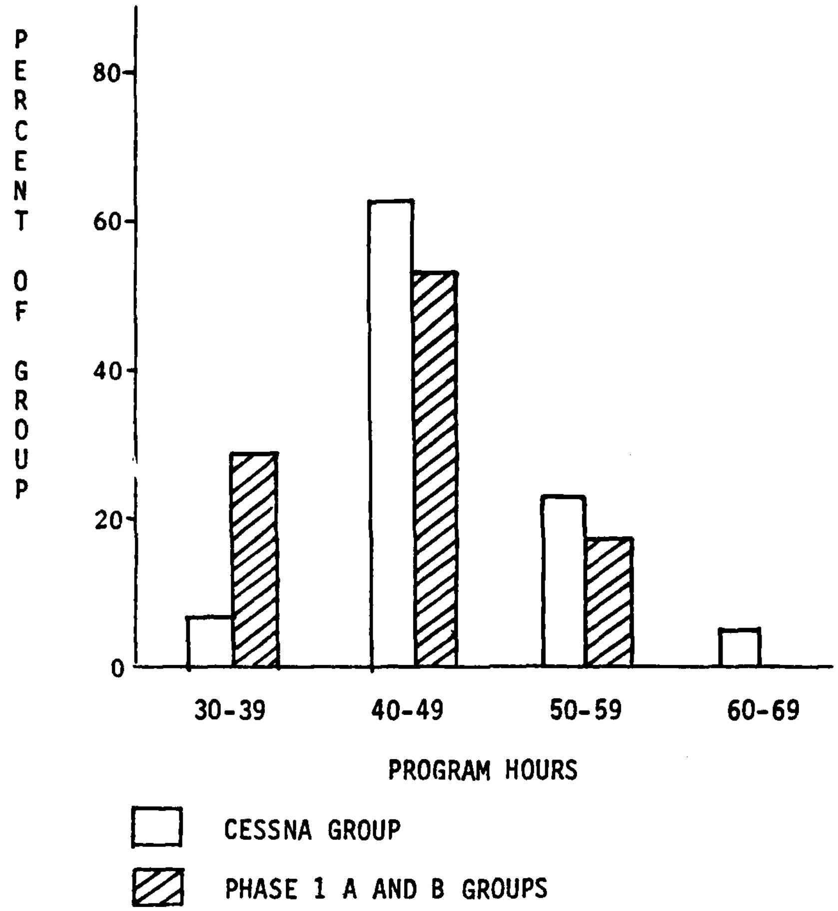


FIGURE 3. COMPARISON OF PROGRAM HOURS BETWEEN CESSNA GROUP AND PHASE I GROUPS

TABLE 5. TRAINING PROGRAM AND EXIT HOURS BY GROUP

GROUP	N	TRAINING PROGRAM HOURS		TOTAL HOURS AT EXIT	
		M	SD	M	SD
Phase I					
Groups A&B	53	42.66	7.80	125.81	14.16
Phase II					
Cessna	18	47.38	6.64	132.37	22.08
Mooney	17	49.24	4.36	142.82	17.16

DATA COLLECTION.

Performance measures and data collection instruments used were identical to those of the Phase I study, since the purpose of this effort was to extend the findings of that study to a different population and instructional setting. Contact and Instrument Pilot Performance Description Records (PPDR), as in the Phase I study, provided measures of contact and instrument checkride performance. The PPDR was first developed by Smith, Flexman, and Houston (1952), and has been modified for use in several studies since that time. The PPDR provides a logical administration sequence for maneuvers to be evaluated, and a standard order of the segments comprising each maneuver. Objective measures are obtained by observing procedures, aircraft instrument indications, and outside references. These observations are then compared to predetermined criteria to assess pilot performance. Provision also was made for recording judgmental assessments by the checkpilot of overall performance for each of the PPDR maneuvers and for each of four flight quality categories pertaining to the entire checkflight. The PPDRs (1) were compatible with FAA and E-RAU checkride procedures; (2) provided comprehensive, objective measures of the maneuvers involved; and (3) permitted efficient manual recording of data during flight.

In addition to the PPDR data, data were collected on the daily progress of the subjects using Daily Progress Records (DPR). Data were also collected on whether the subject passed the FAA practical instrument flight test.

CONTACT PPDR. The Contact PPDR, its associated handbook and contact performance measures are contained in Appendix I. The Contact PPDR provided an objective method for assessing student performance of flying skills required to pass the private pilot checkride. The following eight maneuvers were included:

1. Short field takeoff and departure
2. Approach to landing stall recovery
3. Slow flight
4. 180° instrument turn
5. VOR procedures
6. Turns about a point
7. Traffic pattern
8. Soft field landing

The 180° instrument turn required the student, while flying under the hood, to maintain a relatively constant bank angle, airspeed, and altitude while turning 180°. The VOR problem, which included only identification and initial track-to-station segments, was also performed under the hood.

The maneuvers included a total of 86 separate measures which were of two general types. Both types provided for objective inflight measurement of student performance. The first provided for measurement, along a scale, of deviations from a predetermined criterion. A triangle was provided at the scale midpoint, and was marked if performance was within predetermined tolerance limits. Otherwise, the scale was marked in the appropriate error direction. Tolerance limits were plus or minus five knots for airspeed, five degrees for heading, and 50 feet for altitude. Similar tolerance levels were designated for other flight parameters.

The other type of measure was categorical, and required the checkpilot to mark either a "yes" or "no", depending on whether the pilot executed some desired action and, in some cases, whether the performance was, in the opinion of the checkpilot, within acceptable limits. The performance measure definition was followed in the determination of "acceptability".

INSTRUMENT PPDR. The Instrument PPDR, its associated handbook, and instrument performance measures are contained in Appendix J. This data collection form was more comprehensive than the Contact PPDR, because it was to be used to obtain the primary criterion data for the study. Nevertheless, the Instrument PPDR represented a sample of instrument maneuvers rather than the complete set. Twelve maneuvers were involved:

1. Straight and level flight
2. Magnetic compass turn
3. Slow flight
4. VOR procedures
5. ADF procedures
6. ILS procedures
7. Holding
8. Procedure turn
9. Cross-country operations
10. Radar vectors
11. Emergency procedures
12. Unusual attitude recovery

The maneuvers included a total of 98 separate performance measures of the two general types described for the Contact PPDR. The scoring scheme was also the same as that used for the Contact PPDR.

INSTRUMENT DPR. The adaptation of the PPDR used in the Phase I study to record the daily performance of the students during instrument training was also used in the present study. Data were collected on the following 14 maneuvers:

1. Straight and level flight
2. Airspeed change
3. 180° turn

4. Climb/descent

5. VOR procedures

6. ADF procedures

7. ILS procedures

8. ILS missed approach

9. Holding

10. Procedure turn

11. Cross-country procedures

12. Emergency procedures: Loss of radio communication

13. Emergency procedures: Equipment/instrument malfunction

14. Unusual attitude recovery

As can be seen, with the exception of additional basic instrument maneuvers (2,3, and 4), the DPR measures were essentially the same as those included in the Instrument PPDR. Each maneuver was divided into a number of segments (e.g., initiate, maintain) which in turn were divided into a number of measures (e.g., airspeed, heading). In all, 106 measures were included in the DPR.

An additional requirement was that the DPR provide for repeated scoring of maneuvers across training days. Ten spaces were provided for these repeated measures. The instructor ascertained, on the basis of predetermined criteria or performance measure definitions, whether the observed performance was within acceptable limits. If the performance was acceptable, a check mark was placed in the box adjacent to the measure and under the proper date. If the performance was not satisfactory, an "X" was marked in the box. The DPR, its associated user's guide, and performance measures are contained in Appendix K.

PRACTICAL TEST. Finally, data were collected on whether the student passed his or her FAA practical flight test. These data resulted in a dichotomous variable (i.e., either the student did or did not pass). One subject was not administered the practical test because he did not pass the instrument written examination. All of the remaining 34 subjects passed the practical flight test.

DATA COLLECTION PROCEDURES. The Contact PPDR checkride was administered by either the site manager or the chief instructor pilot after the students had completed the transition phase. The student completed the checkride in the same aircraft type (i.e., Mooney or Cessna) in which he or she would receive instrument training. Both the site manager and the chief instructor were briefed on the use of the Contact PPDRs before using them to collect data. The PPDR forms were checked by scientific personnel following the checkrides to ensure that the data were complete and consistent.

The DPRs were completed by the instructor pilots on a daily basis during the instrument training flights. All instructors received instruction on the use of the forms prior to the start of training. Clearly stated instructions for form completion and a period of time for the instructors to practice completing the forms were provided. The instructors also practiced completing the forms, using one another as subjects, during familiarization flights in the Atlantic City area. In order to ensure standardization of the forms, the site manager or the chief instructor checked the forms on a daily basis during the first few weeks of training. In addition, scientific personnel reviewed the forms on a random basis during the entire period of training.

The Instrument PPDR checkrides were administered by the site manager or the chief instructor after the students had completed their instrument training, and were recommended for the checkride by their instructors. The site manager administered the check to the regular students of the chief instructor. The Instrument PPDRs were checked by scientific personnel following the checkrides to ensure that the data were complete and consistent.

The FAA practical flight test was administered to all students by the FAA Designated Examiner assigned to the FAA Technical Center. The use of the same examiner for all students provided continuity, standardization and reliability for all flight checks.

RESULTS

Two types of measures were employed for both the Contact and Instrument PPDRs. First, error percentages were derived for each maneuver and for the entire checkride by dividing the total number of scored measures into the number of measures that were out of tolerance, and multiplying the resulting fraction by 100. Second, letter grades (A, B, C, D, or F) were assigned by checkpilots to the performance of each maneuver and to each of four "flight quality" categories pertaining to the entire checkride. Letter grades were scaled by assigning a value of 4 for A, 3 for B, 2 for C, 1 for D, and 0 for F. Use of both types of measures was intended to provide evaluative information along two dimensions. Error percentages resulted from mainly objective descriptions of inflight performance, while maneuver letter grades involved checkpilots' subjective judgments concerning student proficiency.

As earlier noted, the major focus in this study was upon student airborne proficiency exhibited on the Instrument PPDR flight check. Therefore, Instrument PPDR error percentages and FAA instrument checkride pass rates were the measures of primary interest. Contact PPDR data will be presented first to provide an indication of the comparability of the two groups' flight skills prior to entry into instrument training. These results will be followed by data pertaining to the Instrument PPDR, the DPR, and to instrument training times, respectively.

Due to comparability of the performance data on Groups A and B from the Phase I study, these data were pooled for purposes of comparisons with performance data acquired on the Cessna aircraft group in the present study. An additional reason for pooling Group A and B data from Phase I for comparison with the Cessna-trained group in the present study concerned mean number of flying hours at the point of entry into the instrument training. The mean entry time for Groups A and B was 83.2 hours, which compares very closely with that of the Cessna group (85.4 hours) at entry. It should be noted, however, that entry times were controlled in Phase I because training was carried out in an institutional setting. Such control was not possible in the present study, resulting in variance among entry times.

CONTACT PPDR.

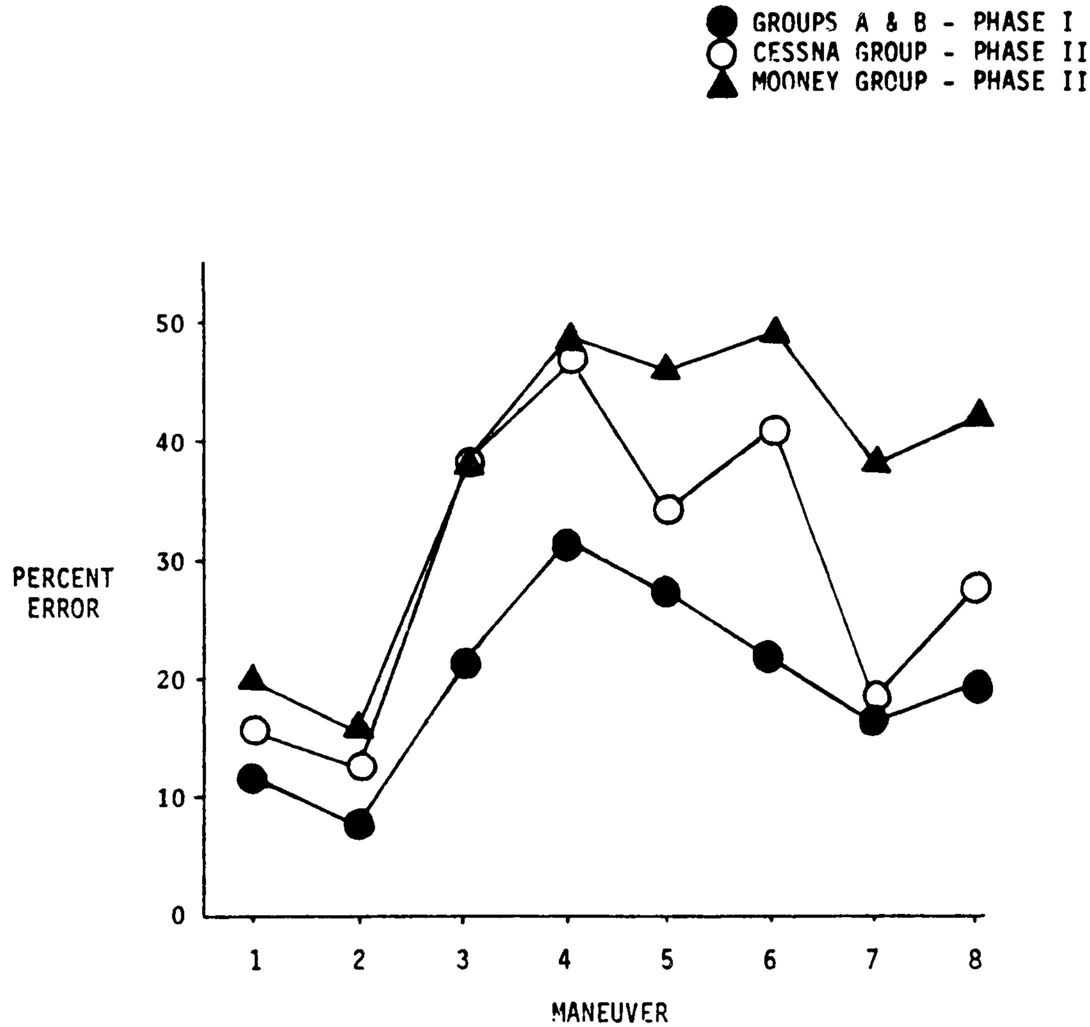
Means (*M*) and standard deviations (*SD*) for total percent error and for average maneuver grades across all Contact PPDR

maneuvers are shown in Table 7 for the Cessna and Mooney aircraft groups, as well as for Groups A and B from the Phase I study. Means for PPDR error percentages were compared statistically using separate one-way analyses of variance (ANOVA). One ANOVA compared error rates of students trained in the Cessna and Mooney aircraft groups, while the other compared the Cessna group with Groups A and B from Phase I. The calculated $\underline{F}$ (1.97) for Cessna vs Mooney groups was not statistically significant. The critical $\underline{F}$ for this comparison was 4.17 at a .05 significance level (DF = 1 and 32). Differences between the error rates of the Cessna-trained group and those of Groups A and B were statistically significant beyond the .05 level, however.[1] Table 6 presents the ANOVA summary for this comparison. As can be seen in Table 7, lower error percentages were exhibited by Groups A and B from Phase I than by Phase II subjects. Figure 4 illustrates this effect for many of the Contact PPDR maneuvers. Differences in error rates among maneuvers were significant ($p < .001$) indicating that some contact maneuvers were more difficult than others for both Phase II groups to perform. The analysis for mean maneuver letter grades (scaled numerically) again resulted in no significant differences between the Cessna and Mooney groups. Further, maneuver grades were not significantly different for the Cessna aircraft group as compared to Groups A and B.

TABLE 6. ANOVA SUMMARY OF CONTACT PPDR ERROR RATES (CESSNA GROUP VS GROUPS A AND B)

SOURCE	df	MS	F	p
Group	1	7,506	5.58	<.05
Subjects	69	1,344		
Measure	7	6,887	18.00	<.001
Group X Measure	7	338	1	NS
Residual	483	383		

[1]The reader may note that the smaller of the two relative differences in error rates resulted in statistical significance. This was due to the larger number of subjects (and hence, degrees of freedom) comprising the pooled data from the Phase I groups, and to the substantial within-groups variance of each Phase II group.



1. TAKEOFF
2. APPROACH STALLS
3. SLOW FLIGHT
4. 180° INSTRUMENT TURN
5. VOR
6. TURNS ABOUT A POINT
7. TRAFFIC PATTERN
8. LANDING

FIGURE 4. MEAN PERCENT ERROR BY CONTACT PPDR MANEUVER

TABLE 7. MEANS (M) AND STANDARD DEVIATIONS (SD) OF SCORES ON CONTACT CHECKRIDE.

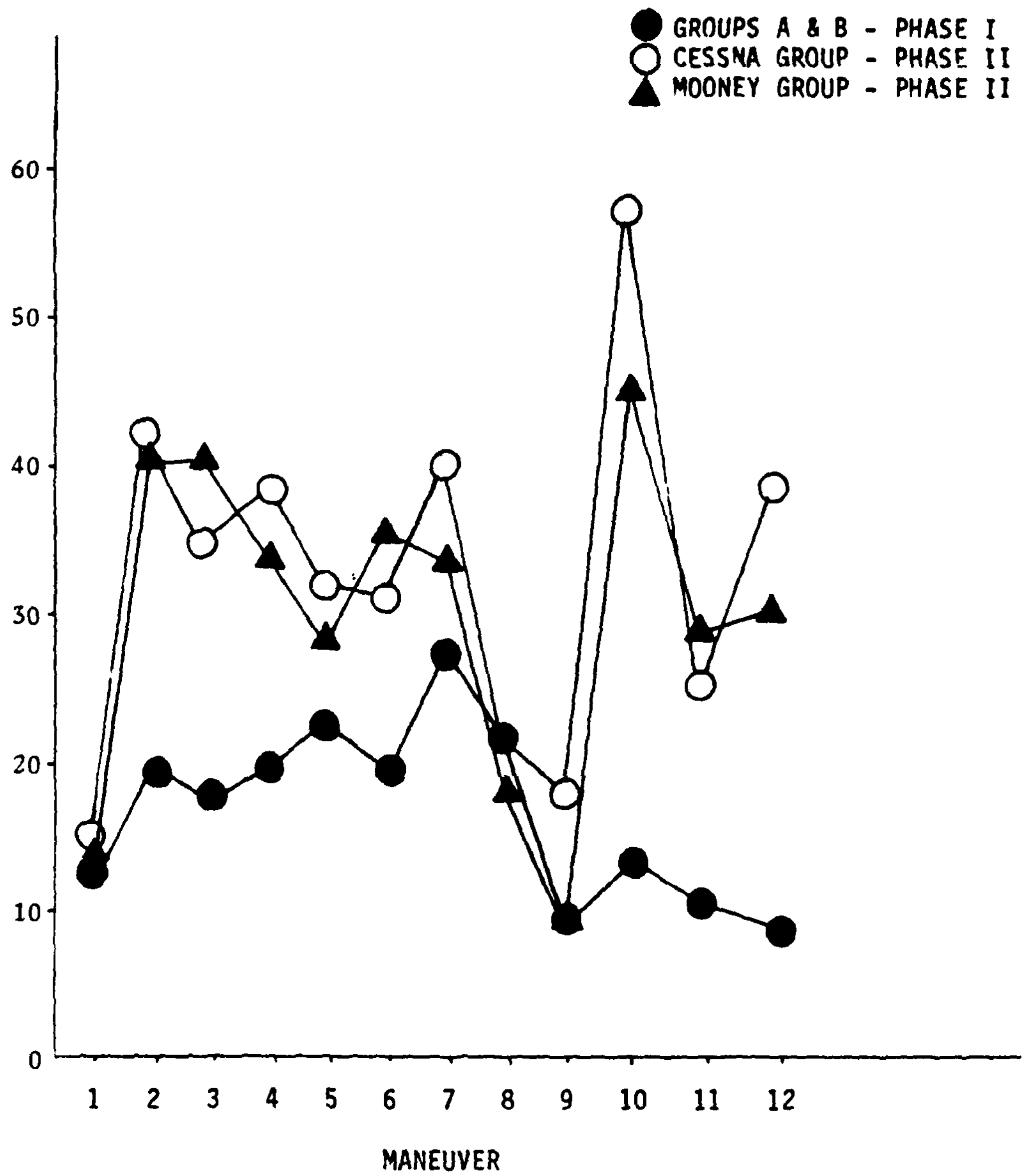
Group	N	PPDR Total % Error		Average Maneuver Grade	
		M	SD	M	SD
Phase I (A & B)	53	20.21	11.63	2.28	.59
Phase II Cessna	18	26.74	15.15	2.50	.46
Mooney	17	36.59	18.70	2.64	.41

Contact PPDR flight quality letter grades, also scaled numerically, were analyzed by separate ANOVAs. Neither the statistical comparisons between the Cessna and Mooney aircraft groups nor those of the Cessna group with Groups A and B was statistically significant.

Overall Contact PPDR results indicated that the Cessna and Mooney groups were comparable with regard to contact flying proficiency upon entry into instrument training. The Cessna group demonstrated significantly higher Contact PPDR error rates than Groups A and B of Phase I.

INSTRUMENT PPDR.

Means (M) and standard deviations (SD) of total error percentages and for average maneuver grades across all Instrument PPDR maneuvers are shown in Table 8. Again, descriptive data pertain to the Cessna and Mooney aircraft groups and to Groups A and B from the Phase I study. For purposes of statistical analysis, separate one-way ANOVAs comparing Cessna with Mooney aircraft group mean error rates and Cessna rates with those of Groups A and B (pooled) of Phase I were performed. No statistically significant error percentage differences between Cessna and Mooney aircraft groups were obtained. Percent error differences between the Cessna aircraft group as compared with Groups A and B from Phase I were significant beyond the .001 level, with the Phase II Cessna aircraft group producing higher error percentages. Table 9 presents the ANOVA summary for this comparison. It also should be noted that a significant ($p < .001$) group-by-maneuver interaction occurred, as did significant differences ($p < .001$) in error rates among Instrument PPDR maneuvers. Mean error rates by the groups on each of the Instrument PPDR maneuvers are shown in Figure 5.



1. STRAIGHT & LEVEL
2. MAGNETIC COMPASS TURN
3. SLOW FLIGHT
4. VOR
5. ADF
6. ILS
7. HOLDING
8. PROCEDURE TURN
9. CROSS-COUNTRY
10. RADAR VECTORS
11. EMERGENCY PROCEDURES
12. UNUSUAL ATTITUDE RECOVERY

FIGURE 5. MEAN PERCENT ERROR BY INSTRUMENT PPDR MANEUVER

TABLE 8. MEANS (M) AND STANDARD DEVIATIONS (SD) OF SCORES ON INSTRUMENT CHECKRIDE.

		PPDR Total % Error		Average Maneuver Grade	
Group	N	M	SD	M	SD
Phase I (A&B)	53	17.77	12.23	2.20	.69
Phase II					
Cessna	18	31.46	12.08	2.67	.53
Mooney	17	30.31	11.86	2.93	.56

TABLE 9. ANOVA SUMMARY OF INSTRUMENT PPDR ERROR RATES (CESSNA GROUP VS GROUPS A AND B).

Source	df	MS	F	p
Group	1	40,545	23.34	<.001
Subjects	68	1,737		
Measures	11	2,438	5.96	<.001
Group X Measures	11	2,111	5.16	<.001
Residual	748	409		

While it is apparent that the Cessna group error rates were consistently higher overall than Groups A and B, it should be noted that the effect resulted mainly from error rate differences on maneuvers performed infrequently (e.g., magnetic compass turns, radar vectors, and unusual attitude recoveries) as opposed to such commonly performed maneuvers as instrument approaches (e.g., VOR and ILS). It is possible that these differences reflect disparities in training emphasis as well as variations in population and training setting.

As with the percent error analysis, separate one-way ANOVAs were performed on the mean maneuver grades. Differences between these grades of Cessna and Mooney aircraft groups were not statistically significant. Comparisons involving the Cessna aircraft group with the Phase I groups were

statistically significant ($p < .001$), with the Cessna aircraft group receiving higher mean letter grades on the Instrument PPDR maneuvers. These data are shown in Table 1. It should be noted that Groups A and B of Phase 1 received an inordinately high percentage of maneuver downgrades (Ds or Fs), as compared to the Cessna group, on Instrument PPDR maneuvers. This significant difference ($p < .01$) is attributed to differences in training settings and to variations among checkpilot criteria.

Grades on the four flight quality categories also were compared using separate one-way ANOVAs. Neither ANOVA resulted in statistically significant differences.

Overall Instrument PPDR results indicated that aircraft complexity had a negligible effect on students' ability to learn instrument flight skills. The Cessna trained group showed significantly higher Instrument PPDR error rates (and paradoxically, higher mean maneuver grades) than Groups A and B from Phase I. The reasons for these differences are unknown. They could have resulted from differences in population, training setting, and/or checkpilot criteria affecting the subjective designations of maneuver letter grades.

DAILY PROGRESS RECORD.

Daily Progress Record (DPR) data for Cessna and Mooney aircraft groups were analyzed by blocking each of the first ten training trials of a given maneuver into pairs, calculating mean error percentages for each pair, and performing a repeated measures ANOVA on the means. Daily training constraints precluded acquiring data on some of the maneuvers. Other maneuvers (e.g., instrument approaches) were not assessed during the early portions of training and were incomplete for later training. Statistical data comparisons therefore were not made on maneuvers for which such constraints occurred. Error data could be meaningfully analyzed over training days for only four instrument maneuvers: straight and level flight, airspeed change, 180° turns, and climbs/descents. None of the calculated Fs for Cessna vs Mooney error rate comparisons was statistically significant. However all Fs for error rates indicated that both groups improved significantly ($p < .05$) over time. In addition, the nature of performance change was virtually the same for both groups. A learning effect, as demonstrated by improvement in proficiency as a function of practice, was thus demonstrated. Figures 6-9 document this increase in proficiency in performing the four maneuvers and show the similarities between the two aircraft groups in this improvement process.

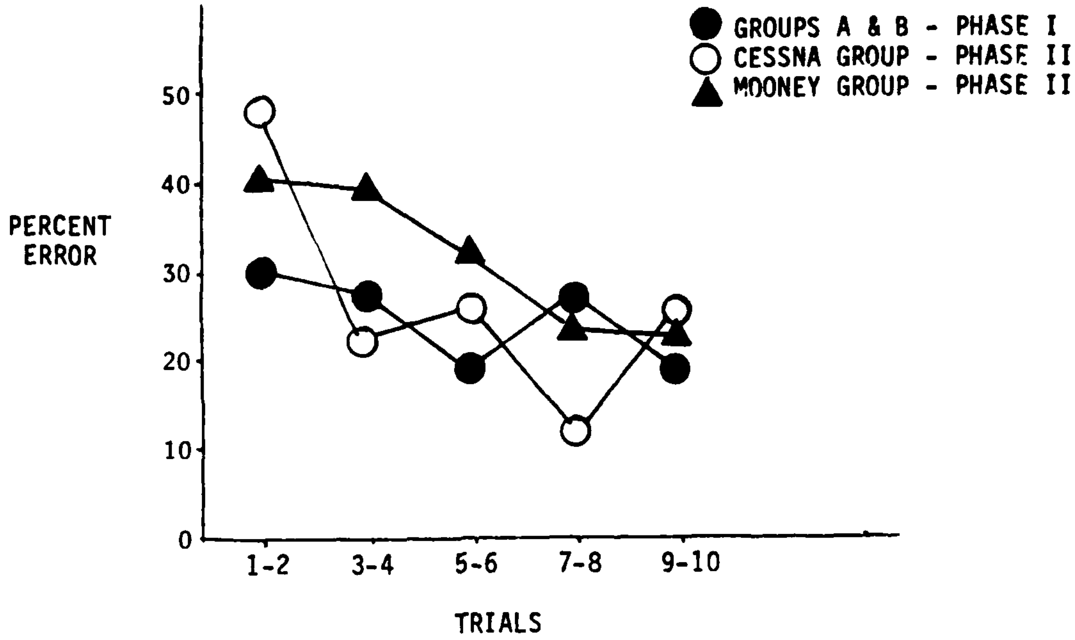


FIGURE 6. MEAN PERCENT ERROR BY INSTRUMENT DPR MANUEVER (STRAIGHT & LEVEL)

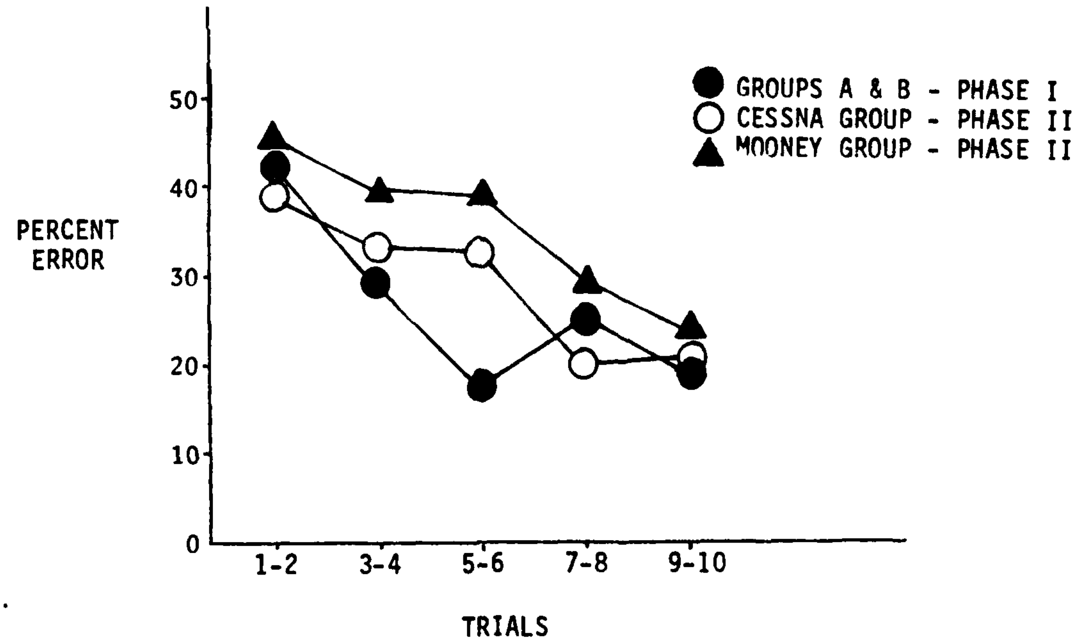


FIGURE 7. MEAN PERCENT ERROR BY INSTRUMENT DPR MANEUVER (AIRSPEED CHANGE)

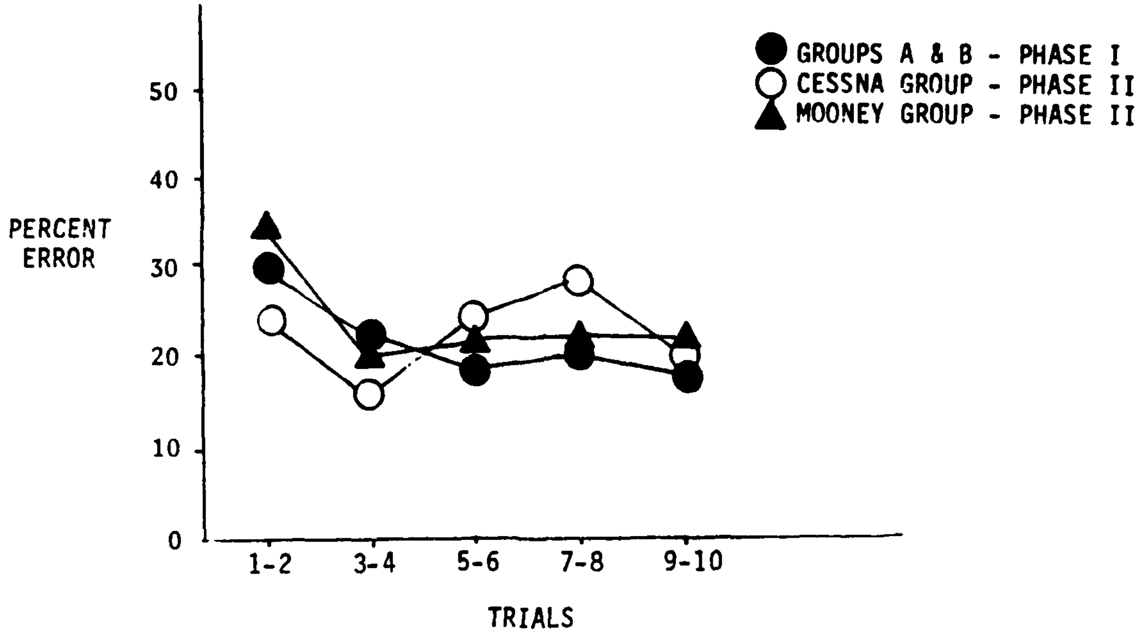


FIGURE 8. MEAN PERCENT ERROR BY INSTRUMENT DPR MANEUVER (180° TURN)

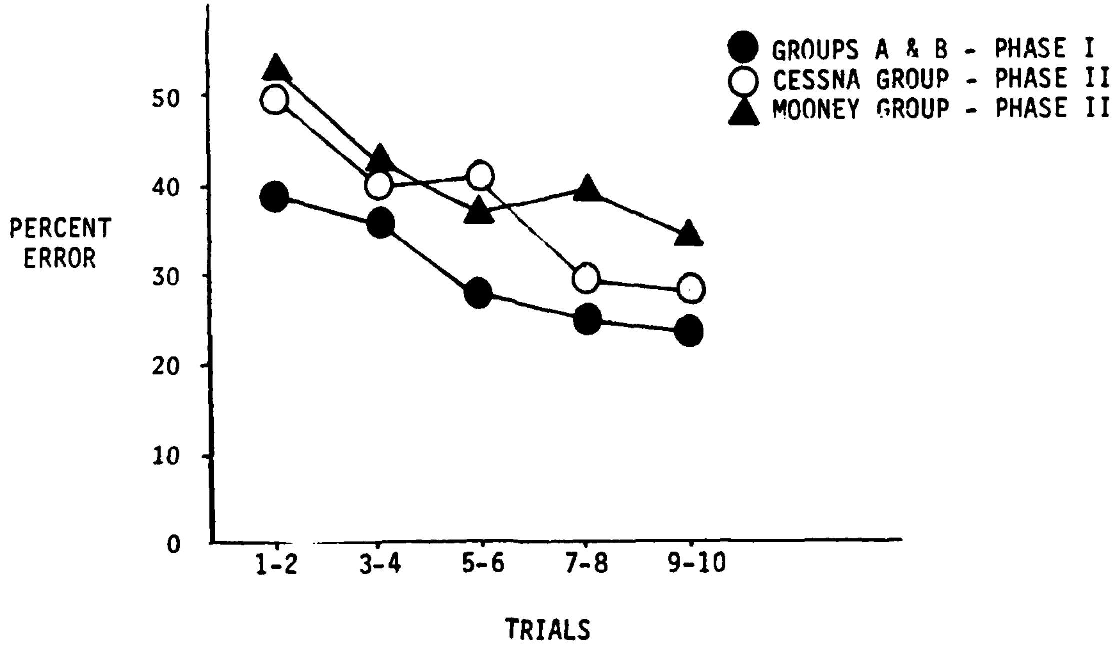


FIGURE 9. MEAN PERCENT ERROR BY INSTRUMENT DPR MANEUVER (CLIMBS & DESCENTS)

Since repeated measures statistical analyses on the DPR data of Groups A and B in the Phase I effort were not feasible, statistical comparisons between the Cessna group and Phase I DPR data could not legitimately be made. An inspection of the two sets of data revealed that observed differences between them were not appreciable either early or late in the training programs.

TRAINING TIME.

The number of training hours required by students to attain a skill level that enabled them to take the instrument checkride was considered to be a measure of importance. Instrument training hours for Cessna and Mooney aircraft groups and for Groups A and B of Phase I were shown in Table 5. Training times as compared by *t* tests of uncorrelated means did not differ significantly for Cessna vs Mooney groups. However, such a test of significance indicated that the Cessna group received reliably more training time ($p < .05$) than did Groups A and B in Phase I. As with Contact PPDR error rates, relatively small absolute differences in training hours produced statistical significance due to a larger number of subjects for Groups A and B. Training data are contained in Appendix F.

FAA CHECKRIDES.

Perhaps the measure of greatest significance as an influence upon potential regulatory change is the ability of the subjects to pass the FAA practical instrument flight test following their instrument training programs. In the present study, all of the students who completed the training program passed their FAA instrument checkride administered by an independent FAA examiner, with the exception of the student who was not eligible to take the checkride because he did not pass the instrument written examination. Hence, at the completion of their training program all students met (or exceeded) FAA instrument checkride standards, as did all students who participated in the Phase I study.

DISCUSSION AND CONCLUSIONS

DISCUSSION.

This study comprised the second phase of an empirical effort to determine the effects of prior flight time upon the ability to acquire and demonstrate instrument flight skills. Results of the initial phase of the study indicated that the amount of pre-instrument training time, within the range investigated, did not affect the ability to acquire instrument flight skills.

Results of the present study support those of Phase I and extend them to an older, more heterogeneous subject population trained in a noninstitutional setting. On the basis of these findings, the amount of total prior flight time (within the 100-200 hour range) does not appear to be a valid indicator of student ability to acquire instrument flying proficiency. While Phase II Instrument PPDR error rates were higher overall than those of comparably experienced groups in Phase I, the outcome of instrument training in both instances was a demonstration of instrument proficiency commensurate with FAA flight check standards. Objective performance measurement instruments such as the PPDR are designed to measure accuracy and precision of flight skills to a level that is beyond that of the requirements set forth by the FAA for passing the instrument checkride. As earlier noted, the greater Instrument PPDR error rates in Phase II conceivably resulted from subject age and vocational factors, as well as possible inflight recording variations due to involvement of different checkpilots in the two phases.

The more complex aircraft had almost no influence on students' instrument learning ability as shown by both objective and subjective grades on the Instrument PPDR.

The higher Instrument PPDR error rates of the Cessna group of this study as compared with Groups A and B from Phase I might lead one to predict that the Cessna group's mean maneuver letter grades would be lower than those of the Phase I groups. That the opposite was obtained is difficult to interpret from a proficiency standpoint. Since the subjective, norm-referenced grading practices of flight instructors are known to be inconsistent in many instances (e.g. Hockenberger and Childs, 1980), these letter grades should not be heavily weighed in the final determination of instrument flying proficiency.

CONCLUSIONS.

1. Phase I and Phase II subject populations differed significantly in their ability to demonstrate the flight skills that are assessed by the Instrument PPDR. This was shown by the significantly higher error rates produced by Phase II students as compared to the aeronautical university students of Phase I. In both phases, however, subjects exhibited the degree of skill required to pass the FAA practical instrument flight test.

2. The relative complexity of the aircraft in which instrument training was conducted had no discernible effects upon instrument flying skill acquisition.

3. For the subject populations, degree of aircraft complexity, and training settings investigated, amount of total flight time had no influence on students' ability to acquire the skills necessary to pass the FAA practical instrument flight test.

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APPENDIX A

PAST RESEARCH ON INTEGRATED TRAINING

INTEGRATED TRAINING.

There is a sizeable body of literature on the acquisition and retention of contact and instrument flight skills. A review of this literature revealed twelve previous empirical studies bearing on the feasibility of early instrument training. These studies were all concerned directly or indirectly with the introduction of instrument flying early in the training process. Some form of such training, termed integrated training when combined with contact training, would appear to offer the greatest potential for eliminating the current operational problem described in the body of this report. These studies were considered relevant to the present effort because of their treatment on content, format, and sequence of contact and instrument training and their implications concerning effects of such training upon pilot proficiency. Following are brief synopses of several of the studies that are especially relevant to present purposes.

CIVIL AVIATION RESEARCH ON INTEGRATED TRAINING. The first reported attempt to integrate contact and instrument training was made by Lee (1935) at the Boeing School of Aeronautics. He trained 16 students solely by reference to instruments during their first 23 hours of training. This was followed by contact training and later by a combination of the two. Results, although subjectively evaluated, were positive and prompted Lee to conclude that students enrolled in long-term flight training courses should begin instruction under the hood. However, the study employed no control groups, used highly impressionistic assessments of student performance, and failed to integrate contact and instrument skills at the start of training.

Two decades elapsed before further work in this area was reported, at which time Ritchie and Michael (1955) examined the transfer effects of instrument-to-contact training, and of contact-to-instrument training. Groups of students with no flight experience were trained either on instruments followed by contact or on contact followed by instruments. There were 11 students in each group. Relatively objective measures of performance were obtained on two maneuvers--straight and level flight and 180° turns. Upon attainment of criterion performance on both maneuvers by one method, students commenced training on these same maneuvers by the other method. More trials were required to learn instruments than contact. Of greater significance, however, was the finding that contact and instrument flying had very different transfer effects upon each

other. Specifically, contact-trained subjects demonstrated a negative 22% transfer effect on learning instruments, while instrument-trained subjects showed a positive 47% transfer effect on learning contact. Ritchie and Michael concluded that the difference in the direction of transfer might be expected to reduce the overall learning time for both forms of training when instrument skills are trained before contact. They further indicated that the traditional approach to flight training has been at least wasteful of training efforts, and may have led "a whole generation" of pilots to hate instruments because instrument flight introduces actions that compete with strongly-established contact habits.

A later study by Ritchie and Hanes (1964), using a greater number of subjects, partially replicated the finding of Ritchie and Michael (1955). Transfer from instrument to contact training was again found to be positive. However, nonsignificant positive transfer effects from contact to instrument learning also were observed. Not surprisingly, significantly fewer trials (61%) were required to learn contact than instrument flying, a result suggested by the earlier study. This finding led the investigators to conclude that instrument flying is reliably more difficult to learn than contact flying.

A methodological weakness in these studies was the selection of only two basic tasks (straight and level flight and 180° turn maneuvers) on which to obtain performance measures. There is a question as to whether findings related only to these tasks can be generalized to all the interactive cognitive, procedural, decisional, and psychomotor skills required for general operation of aircraft. There is a need for a more representative range of flight tasks before such generalizations can be made reliably.

A study conducted by Williams, Houston, and Wilkerson (1956) at the University of Illinois Institute of Aviation addressed the feasibility of incorporating both instrument and contact flight training within the scope of the private pilot syllabus. The first 3.2 hours of training were spent either in a ground trainer or under the hood in the aircraft. Contact flying was then introduced and interspersed with instrument flying thereafter. All the subjects passed the private pilot checkride and, by means of subjective evaluations, showed substantial ability to engage in basic instrument flight. Williams, et al. noted that the integrated format did not hamper students' contact proficiency; that they were enthusiastic about instrument flying and motivated to learn more about it; and that a few of the students were able to pass the basic airwork portion of a standard instrument checkride. The flight instructors who served in the project felt that the

integrated contact/instrument concept should be incorporated into all private pilot training programs.

Seltzer (1958), at West Virginia University, conducted a study with ten subjects to determine whether they could be trained effectively as private pilots in a course combining instrument and contact flight training. All subjects passed the private checkride after training times not appreciably greater than students normally required at that school. Of the ten experimental subjects, two participated in another 20 hours of instrument training after which they took standard instrument checkrides.[1] One of the students passed the flight check. The FAA examiner who administered the ride noted that this student was an example of what can be accomplished with carefully controlled training, high instructor proficiency, and able students. The other student failed the checkride, but his examiner indicated that a few more hours of training would likely bring him up to full instrument standards. Seltzer concluded that some instrument training should be included in the initial phases of flight instruction since such training appears to facilitate both contact and instrument skill acquisition.

Another study was conducted by Seltzer the following year (Seltzer, 1959) to determine whether a relationship existed between the amount of contact flying experience of general aviation pilots and the amount of instrument instruction required to develop minimally acceptable instrument proficiency. Sixty-six qualified private pilots from two states were used as subjects. A five-point subjective grade scale was used and the content and sequence of instrument flight checks were standardized. Seltzer found no relationship between previous contact experience and the learning of instrument flight skills.

A study was performed at Ohio State University to determine the effects of an integrated VFR-IFR curriculum on both contact and instrument flying skills (Easter & Hubbard, 1968). The integrated curriculum consisted of 75 total flight hours. All maneuvers were introduced using instrument references, with the relationships between them and visual references emphasized. Performance of the experimental students receiving this integrated training was compared statistically to that of

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[1]These students did <u>not</u> meet the experience and training requirements as prescribed by the FAA for the instrument rating. As described in this report, those requirements include 200 hours of total flight time and 40 hours of instrument time under actual or simulated conditions. These two students had approximately 65 total flight hours and 25 instrument hours upon taking their instrument flight check.

private pilot and instrument pilot control groups at various points during the training sequence. Both objective and attitudinal data indicated a difference slightly in favor of the experimental group with regard to contact flying skills. However, instrument skills of the experimental group were found to be markedly inferior to those of the instrument control group.[1] It was concluded that 75 hours of flight time was insufficient to train the "judgment, self-reliance, and seasoning" necessary to operate under IFR in the complex ATC network. it was not possible, however, to identify in the data obtained the variable(s) responsible for these instrument skill deficiencies. The authors presented several cogent interpretations of their results, including the lack of sufficient solo cross-country time by the experimental group, possible instructor recording differences, and a lack of sufficient training time and content relative to the complex time-shared aspects of instrument flying.

Like most of the work preceding it, the design of the Easter and Hubbard (1968) study permitted neither definitive explanations concerning <u>why</u> significant differences were obtained, nor reliable estimates of additional time necessary to bring the experimental group up to FAA instrument rating standards. The present study attempted to overcome some of the methodological deficiencies of past attempts. It was recognized, however, that many such deficiencies are inherent in attempts to gather performance data of this nature within operational settings.

<u>MILITARY AVIATION RESEARCH ON INTEGRATED TRAINING</u>. All three branches of the military have investigated some form of early integrated contact/instrument training. While there remains some controversy as to how much and what type of instrument training is sufficient to produce combat-ready aviators, there has been a definite trend toward introducing instrument skills very early in the training sequence and reinforcing the use of those skills by student pilots throughout training.

The Air Force, through its Primary Flight Training Research Unit (1957), conducted an experiment at Graham AFB, Marianna, Florida, in 1956-57 for the purpose of evaluating the integrated training concept. Two primary pilot classes were trained using this concept. One class used the block approach, and the other the simultaneous (instrument/contact) cue method.

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[1]The instrument control group consisted of 15 students whose mean total flight time at the beginning of the project was 367 hours, a confounding variable as reported by the authors because the experimental subjects began training with zero prior flight hours.

Data consisted of the subjective reports of the participating instructors. While the instructors generally were of the opinion that the simultaneous use of contact and instrument cues resulted in informational overload for the beginning student, the instructors were unanimous in their desire to use the following instructional sequence:

1. Three hours of ground trainer instruction to teach pitch, bank, and power control;

2. Three hours of pitch, bank, and power control instruction in the aircraft under the hood;

3. A contact check to include solo flight; and

4. The remainder of training using the simultaneous cueing method.

Overall conclusions based upon subjective flight check data were that integrated training slightly improved primary pilot performance; that the simultaneous cue method is capable of producing a level of proficiency greater than that resulting from the use of conventional methods; and that the use of integrated concepts should be extended into basic (as well as primary) training to promote continuity.

In 1957, the Army Aviation School examined, on a preliminary basis, the feasibility of integrated fixed-wing training. Investigators and training managers were sufficiently optimistic about the results of that study to recommend that a larger-scale assessment of integrated training be conducted. In response to that recommendation, a comprehensive, well controlled study of integrated training was carried out. This study, known as INTACT, was performed in 1960-61 by the Human Resources Research Office (HummRRO) and the results were published by Prophet and Jolley (1969).

The major purposes of INTACT were to determine: (1) contact and instrument proficiency levels of primary flight students trained under an integrated concept relative to those trained using standard methods; (2) rates of attrition for integrated and non-integrated classes; and (3) the extent to which integrated training effects exhibited during the early phases of training would be demonstrated during advanced contact and instrument training.

Three groups of 36 students each received primary flight training under either integrated or non-integrated methods. The performance of these students was compared throughout and at the completion of training using objective measures. Other proficiency measures employed in this study were attrition, training time, and subjective checkride grades.

Results indicated no significant performance differences among groups using any of the objective measures at any point during either primary or advanced training. The subjective numerical checkride grades were significantly higher ($p < .05$) for integrated groups than non-integrated groups during primary training. No significant differences were obtained for advanced phases. The conclusions were that integrated primary flight training produces advantages in primary flight proficiency, but that those advantages are not manifest in advanced flight performance.

The overall body of research data concerned with integrated training suggests that it might be possible--even likely--that private pilots can learn instrument skills that meet minimum required proficiency levels in fewer than 200 hours total flight time.

APPENDIX B

FAA EXEMPTION NO. 3237

This appendix contains Exemption No. 3237, which was issued by the FAA on May 27, 1981. The exemption allows the subjects who complete the research program to receive an instrument rating without meeting the minimum total pilot experience requirements of Section 61.65 (e)(1) of the FAR, if they have otherwise passed all required tests.

Exemption No. 3237

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20591

* *

In the matter of the petition of

FEDERAL AVIATION ADMINISTRATION
TECHNICAL CENTER

for an exemption from §§ 61.39(a)(2) and 61.65(e)(1) of the Federal Aviation Regulations

* *

GRANT OF EXEMPTION

By letters dated February 25 and April 14, 1981, the Federal Aviation Administration Technical Center (FAATC), Atlantic City Airport, New Jersey 08405, petitioned on behalf of approximately 30 enrollees in the Airman Research Program for an exemption from §§ 61.39(a)(2) and 61.65(e)(1) of the Federal Aviation Regulations (FAR) to allow the enrollees to take the flight test for an instrument rating without meeting the minimum total pilot experience requirements of § 61.65(e)(1) of the FAR.

Section 61.39(a)(2) specifies, in pertinent part, that to be eligible for a flight test for an instrument rating issued under Part 61, an applicant must have the applicable aeronautical experience prescribed in that part.

Section 61.65(e)(1) requires an applicant for an instrument rating to have a total of 200 hours of pilot flight time, including 100 hours as pilot in command, of which 50 hours are cross-country in the category of aircraft for which an instrument rating is sought.

Additional information from the petitioner indicates that the research program resulted from a special study the National Transportation Safety Board conducted on fatal, weather-involved, general aviation accidents. This study examined the circumstances surrounding that type of accident for a 9-year period. It showed that the predominant number of pilots involved held private pilot certificates, were not

instrument rated, and had between 85 and 185 total flight hours.

The FAATC Airmen Research Program enrollees are men and women who come from various educational backgrounds and range in age from their 20's to early 50's. Flight training will be conducted in single-engine fixed and retractable gear airplanes. The flight instructors are experienced instrument flight instructors from Embry-Riddle Aeronautical University who are accustomed to determining the decisionmaking abilities of students with various amounts of flight time. It is anticipated that the enrollees will have from 90 to 150 hours total flight time at the conclusion of their instrument training. The subjects will be required to pass the instrument rating (airplane) written test and the flight test prescribed in Advisory Circular No. 61-65A, "Instrument Pilot Airplane," prior to the addition of an instrument rating on their pilot certificates. According to the petitioner, the standard Federal Aviation Administration written and flight tests plus the instructors' evaluation of the enrollees' judgmental abilities will ensure an equivalent level of safety.

Because a significant number of low-time noninstrument-rated pilots are involved in weather-related accidents, the FAA has had a continuing interest in examining the total pilot flight time criteria for meeting the requirements for adding an instrument rating (airplane) to a pilot certificate. The certification standards for issuance of private pilot certificates and instrument ratings under Part 61 were significantly upgraded in November 1974 in keeping with the increased technology then available. The FAA believes that petitioner's research program will provide an opportunity to gather data and evaluate the knowledge and skills of low-time pilots who have been certified under the current regulations. This information will be useful in future reviews of instrument rating minimum experience requirements.

The FAA has determined that a level of safety equivalent to §§ 61.39(a)(2) and 61.65(e)(1) can be achieved with the petitioner's training plan. This will be insured not only because the subjects will take the prescribed written and flight tests for certification, but they will also be evaluated to ensure that their in-flight judgmental ability is equivalent to pilots who possess the required levels of flight experience.

A summary of the petition was published in the Federal Register on April 6, 1981 (46 FR 20652). No comments were received.

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in Section 313(a) and 601(c) of the

Federal Aviation Act of 1958, delegated to me by the Administrator (14 CFR 11.53), enrollees in the Airman Research Program instrument rating course conducted by the Federal Aviation Administration Technical Center are granted an exemption from §§ 61.39(a)(2) and 61.65(e)(1) of the FAR to permit them to take the flight test for an instrument rating without meeting the minimum total pilot experience requirements of § 61.65(e)(1). The exemption is subject to the following conditions and limitations:

1. This exemption applies only to students enrolled in the Airman Research Program who participate in the entire course of instrument training conducted by the Federal Aviation Administration Technical Center.

2. Applicants not meeting the minimum flight experience requirements of § 61.65(e)(1) will have the notation "HOLDER DOES NOT MEET THE PILOT FLIGHT EXPERIENCE REQUIREMENTS OF ICAO" placed on their reissued pilot certificates when the flight tests have been satisfactorily completed. Upon presentation of satisfactory written evidence that the enrollee has met this requirement, he or she is entitled to a new certificate without the endorsement.

3. A copy of this exemption will be given to the FAA inspector or designated pilot examiner administering the flight test to be made a part of the applicant's certification file.

Unless sooner superseded or rescinded, this exemption terminates December 31, 1981.

Issued in Washington, D.C., on May 27, 1981

APPENDIX C

STATISTICAL ANALYSIS PROCEDURES

In presenting data in this report, several types of statistics are used. To summarize the general nature or typical value for a group of measures, descriptive statistics such as the Arithmetic Mean (*M*) and Standard Deviation (*SD*) are used. The *M* is that statistic which is commonly referred to as "the average," while the *SD* is an indicator of the degree of variability among individual measures about the group *M* value.

In evaluating whether two or more sets of data (e.g., Groups A, B, and C) differ to a degree greater than might be expected by chance, various statistical significance tests are used. In the present report, these are the Student's *t* test and the "analysis of variance (ANOVA)."

Degree of departure from chance expectation is expressed in terms of probability statements. For example, the expression $p < .05$ means that the probability is less than five in 100 that the difference is due to chance alone; $p < .01$ means that the probability is less than one in 100, and so on. Thus, the smaller the probability figure, the more significant a difference is and the less likely it is due to chance variation. In keeping with statistical convention, differences are not considered statistically significant here unless the probability is 5 in 100 or less.

The ANOVA test yields a statistic called the *F* ratio, which is the ratio of two variance estimates, and it is this *F* statistic that allows the probability determination. Similarly, the *t* test yields a statistic that permits a probability determination of the significance of a difference. In both the ANOVA and *t* tests, reference is made to *df*, or degrees of freedom. The *df* refers basically to the number of independent measures on which the test is based.

The reader desiring more information of such statistical analysis and test procedures is referred to any one of the large number of standard statistical textbooks available. For example, see:

Edwards, A. L. *Statistical analysis*. New York: Holt, Rinehart, & Winston, 1974.

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APPENDIX D

SUBJECT DATA

This appendix contains background data for the subjects in the Cessna and Mooney groups who completed the experiment. The data include: (1) subject number; (2) age at the beginning of training; (3) sex; (4) occupation; (5) flight time at selection including total time in last six months, cross country time, and instrument time; (6) private pilot written examination score; (7) transition time and (8) entry flight time. The entry flight time is the time at the start of instrument training and includes total flight time at selection and all transition flight time.

SUBJECT DATA: CESSNA 172 GROUP

SUBJECT NUMBER	AGE	SEX	OCCUPATION	FLIGHT TIME AT SELECTION TOTAL	LAST 6 MOS	PIC	CROSS C'NTRY	INST.	PRIVATE PILOT WRITTEN	TRANS-ITION TIME	ENTRY FLIGHT TIME
1	26	M	Engineer	75.1	0	24.4	18.0	7.3	80	5.3	80.4
2	31	M	Engineer	69.0	0	20.0	10.0	4.5	93	6.9	75.9
3	50	M	Engineer	73.1	0	21.0	25.0	5.1	82	6.4	79.5
4	23	F	Secretary	71.3	12.0	23.1	27.6	4.5	88	5.0	76.3
5	33	F	Comp Spec	68.8	20.0	25.0	32.0	4.5	90	3.4	72.2
6	52	M	Mechanic	110.7	0	44.0	53.0	0	-	6.0	116.7
7	31	M	Engineer	53.7	0	22.0	18.0	3.9	88	4.9	58.6
8	28	M	Video Spec	75.5	5	21.0	18.0	3.0	78	4.6	80.1
9	52	M	Engineer	118.5	3.3	50.0	45.0	4.0	-	5.9	124.4
10	38	M	Technician	74.1	42.5	21.0	18.0	3.4	82	7.5	81.6
11	31	M	Engineer	56.5	0	24.8	18.8	1.8	100	6.5	63.0
12	43	M	Engineer	104.9	10.0	43.3	20.0	1.8	87	5.1	110.0
13	52	M	Engineer	75.3	25.0	36.5	18.0	6.5	88	3.3	78.6
14	33	M	Engineer	82.7	0	44.4	20.0	6.6	97	5.4	88.1
15	26	M	Engineer	84.4	60.0	26.7	21.0	6.1	83	4.9	89.3
16	50	M	Mechanic	76.6	0	23.0	35.0	1.3	80	6.2	82.8
17	43	M	Technician	81.3	73.6	21.0	18.0	3.9	79	6.5	87.8
18	35	M	Engineer	87.6	46.6	40.4	21.0	0	98	4.6	92.2
M	37.6			80.0	16.6	29.5	24.2	3.8	87.1	5.5	85.4
SD	10.1			16.9	23.5	10.3	10.8	2.2	7.1	1.1	17.0

SUBJECT DATA: MOONEY GROUP

SUBJECT NUMBER	AGE	SEX	OCCUPATION	FLIGHT TIME AT SELECTION: TOTAL	LAST 6 MOS	PIC	CROSS C'NTRY	INST.	PRIVATE PILOT WRITTEN	TRANS-ITION TIME	ENTRY TIME
19	29	F	Mathematician	80.7	59.4	30.0	21.0	2.4	95	7.1	87.8
20	45	M	Pub Relations	108.9	5.0	25.0	30.0	3.5	85	6.0	114.9
21	50	M	Elec Tech	84.1	0	40.0	25.0	6.6	79	5.7	89.8
22	32	M	Engineer	81.6	60.7	25.0	18.0	6.4	100	8.6	90.2
23	25	M	Engineer	95.4	50.0	30.4	32.0	5.5	-	4.7	100.1
24	37	M	Lawyer	75.8	0	14.3	22.0	3.6	96	6.7	82.5
25	38	M	Engineer	109.9	30.7	74.3	50.9	4.0	95	6.9	116.8
26	24	M	Engineer	87.5	87.5	20.8	23.5	3.9	98	7.5	95.0
27	38	M	Engineer	59.9	35.0	20.1	17.1	2.9	85	6.1	76.0
28	33	F	Program Spec	102.9	4.9	-	27.7	3.3	97	4.6	107.5
29	34	M	Engineer	95.2	38.6	30.2	20.9	1.9	95	5.6	100.8
30	32	M	Engineer	94.3	20.0	28.0	20.0	3.9	95	7.8	102.1
31	42	M	Engineer	70.4	65.6	20.0	23.0	3.2	78	6.5	76.9
32	25	M	Engineer	77.3	77.3	28.0	21.0	3.0	85	6.6	83.9
33	55	M	Duty Officer	109.6	3.7	35.0	28.0	3.7	84	6.1	115.7
34	45	M	Air Traf Cont	70.6	12.1	-	-	3.5	75	6.2	76.8
35	26	M	Engineer	69.0	50.0	37.7	25.0	2.6	96	6.2	75.2
M	35.88			87.2	35.3	30.6	24.7	3.8	89.9	6.4	93.7
SD	9.16			14.6	28.7	14.0	8.5	1.3	8.1	1.0	14.4

APPENDIX E

INSTRUCTOR DATA

This appendix contains background data for the instructors used in the study. Included are age, sex, education, total flight time, instrument time, total dual time while giving instruction, and dual time while giving instrument instruction.

INSTRUCTOR BACKGROUND DATA

Instructor	Age	Sex	Education	Total Flight Time	Instrument Time	Dual Given	Instrument Dual Given
Site Manager	28	M	AS	2800	200	1200	250
Chief Instructor	23	M	BS	2000	100	800	250
Instructor No. 1	25	M	BS	2300	225	800	140
Instructor No. 2	25	M	BS	1500	100	1160	330
Instructor No. 3	20	F	BS	700	160	500	200
Instructor No. 4	23	F	BS	2000	75	300	200
Instructor No. 5	22	M	BS	975	100	425	30
<u>M</u>	23.7			1753.6	137.1	740.7	200
<u>SD</u>	26			741.1	58.0	352.5	95.2

APPENDIX F

TRAINING DATA

This appendix contains training data for subjects who completed the experiment. Included in the data are: (1) instrument written examination scores; (2) simulator time during the program; (3) aircraft time during the program; and (4) total time during the program. Times in this appendix do not include times completed during the transition phase.

INSTRUMENT TRAINING DATA: CESSNA GROUP

SUBJECT NUMBER	INSTRUMENT WRITTEN	SIMULATOR HOURS	AIRCRAFT HOURS	PROGRAM HOURS
1	81	8.7	38.6	47.3
2	88	13.0	33.7	46.7
3	69	15.8	30.6	46.4
4	84	11.8	33.0	44.8
5	81	10.9	28.9	39.8
6	71	18.5	42.1	60.6
7	94	14.5	31.3	45.8
8	70	9.8	31.3	41.1
9	78	19.3	39.9	59.2
10	75	12.1	32.8	44.9
11	96	13.2	32.5	45.7
12	80	15.1	38.8	53.9
13	94	16.3	34.8	51.1
14	99	12.5	32.0	44.5
15	99	9.9	35.6	45.5
16	79	11.2	21.8	33.0
17	86	13.8	40.0	53.8
18	88	11.7	37.1	48.8
<u>M</u>	84.0	13.23	34.16	47.38
<u>SD</u>	9.69	2.92	4.87	6.64

INSTRUMENT TRAINING DATA: MOONEY GROUP

SUBJECT NUMBER	INSTRUMENT WRITTEN	SIMULATOR HOURS	AIRCRAFT HOURS	PROGRAM HOURS
19	96	11.9	38.5	50.4
20	91	14.9	47.0	61.9
21	85	13.0	38.3	51.3
22	100	11.8	35.5	47.3
23	96	12.8	30.7	43.5
24	93	10.2	36.3	46.5
25	95	13.4	38.2	51.6
26	90	10.9	41.5	52.4
27	96	7.8	38.0	45.8
28	80	14.6	36.5	51.1
29	89	11.1	33.8	44.9
30	93	10.2	36.1	46.3
31	89	10.1	34.7	44.8
32	73	15.5	32.9	48.4
33	76	12.5	40.5	53.0
34	89	12.8	35.3	48.1
35	73	6.9	42.9	49.8
$\underline{M}$	88.47	11.79	37.45	49.24
$\underline{SD}$	8.35	2.33	3.94	4.36

APPENDIX G

MANEUVERS INCLUDED IN TRANSITION FLIGHT TRAINING

This appendix contains the maneuvers which were reviewed during the transition phase of training. The maneuvers are representative of basic contact flight skills, and were included to ensure currency in the aircraft and recency of experience for all subjects prior to the start of instrument training.

Maneuvers for both aircraft:

1. Normal takeoff
2. Turns
3. Steep turns
4. Slow flight (w/wo flaps)
5. Minimum controllable airspeed
6. Stalls
7. Forced landings
8. Emergency procedures
9. Traffic pattern entry
10. Normal approach/landing
11. Short field TO/landing
12. Soft field/TO/landing
13. Crosswind TO/landing

Maneuvers for complex aircraft only:

1. Manifold pressure control
2. Propeller control
3. Fuel system control
4. Landing gear control

APPENDIX H

INSTRUMENT FLIGHT TRAINING PROGRAM

This appendix contains information pertaining to the three phases of the instrument training program. Specifically, it contains the objectives and standards for each phase, and brief descriptions of the lessons in the training phases.

PHASE I BASIC ATTITUDE INSTRUMENT (BAI) AND RADIO NAVIGATION

OBJECTIVE: To introduce, develop, and evaluate the ability of the student to maneuver the aircraft during basic attitude operations using instrument references only. To develop an understanding of the ADF and VOR electronic navigation systems.

STANDARDS: The student performance will be evaluated on his/her ability to make accurate and timely computations, maintain orientation and assigned flight path, and make prompt and accurate responses to, while complying with, ATC navigation instructions. In addition, the student should be able to maintain altitude within ± 100 feet, heading within ± 10 degrees, and airspeed within ± 10 knots of that assigned.

LESSON 1	ORIENTATION	
LESSON 2	BAI FAMILIARIZATION	Procedures Trainer
LESSON 3	BAI FAMILIARIZATION	Aircraft
LESSON 4	BAI FLYING	Procedures Trainer
LESSON 5	BAI FLYING	Aircraft
LESSON 6	PARTIAL PANEL	Aircraft
LESSON 7	PARTIAL PANEL	Aircraft
LESSON 8	RADIO NAVIGATION(ADF/VOR)	Procedures Trainer
LESSON 9	RADIO NAVIGATION(ADF/VOR)	Aircraft
LESSON 10	BAI & RADIO NAV. PHASE CHECK	Aircraft

PHASE II INSTRUMENT APPROACH AND TERMINAL PROCEDURES

OBJECTIVE: To introduce, practice, and evaluate the student in the theory and use of electronic approach systems and equipment.

STANDARDS: This phase of training will be complete when through an oral and flight check it is determined that the student has an understanding of and can safely operate an aircraft utilizing the approach systems in terminal operations.

LESSON 11	HOLDING PROCEDURES	Procedures Trainer
LESSON 12	HOLDING PROCEDURES	Aircraft
LESSON 13	ADF APPROACH	Procedures Trainer
LESSON 14	ADF APPROACH	Aircraft
LESSON 15	VOR APPROACH	Procedures Trainer
LESSON 16	VOR APPROACH	Aircraft
LESSON 17	ILS APPROACH	Procedures Trainer
LESSON 18	ILS APPROACH	Aircraft
LESSON 19	REVIEW ALL APPROACHES	Aircraft
LESSON 20	REVIEW ALL APPROACHES	Aircraft
LESSON 21	REVIEW ALL PREVIOUS MATERIAL	Aircraft
LESSON 22	APPROACH/TERMINAL PROCEDURES PHASE CHECK	Aircraft

PHASE III CROSS COUNTRY/FINAL COURSE REVIEW

OBJECTIVE: To teach, develop, and evaluate the understanding and ability of the student to efficiently plan cross-country IFR flight and demonstrate the use of all procedures involved in departure, enroute, and terminal operations.

STANDARDS: This phase will be complete when the student demonstrates through an oral and flight check that he/she has the knowledge and ability to operate an aircraft under simulated or actual IFR conditions within the National Airspace System involving the use of departure, enroute, and terminal procedures.

LESSON 23	CROSS COUNTRY PLANNING & FLIGHT	Aircraft
LESSON 24	CROSS COUNTRY PLANNING & FLIGHT	Aircraft
LESSON 25	250 MILE CROSS COUNTRY (FAR 61.65 c(4)	Aircraft
LESSON 26	250 MILE CROSS COUNTRY	Aircraft
LESSON 27	REVIEW ALL COURSE MATERIAL	Aircraft
LESSON 28	FINAL/COURSE COMPLETION PHASE CHECK	Aircraft

APPENDIX I

PILOT PERFORMANCE DESCRIPTION RECORDS (PPDR) FOR THE CONTACT CHECKRIDE

This appendix presents materials for the Contact Checkride PPDR as they were adapted for the present experiment. Three items are included. First, the Handbook, which begins on page I-2, describes the PPDR and gives instructions for its use. Second, performance measure definitions and guidelines for recording data begin on page I-8. Third, PPDR forms used for recording begin on page I-13.

Contact Checkride Handbook

Pilot Performance Description Record (PPDR)

I. Purpose

A. General - to provide a method of clearly describing and documenting student pilot performance

B. Specific - to provide objective performance data for evaluating contact performance of students in various training tracks.

II. Guiding Principles

A. to obtain a maximum of descriptive and specific judgmental information with a minimum of inflight marking

B. to be made compatible with existing FAA and E-RAU checkride procedures

C. to provide a snapshot sample of student performance of those flying skills required to pass the Private Pilot Checkride.

III. PPDR Characteristics and General Utilization

A. Each flight maneuver in this PPDR has been analyzed and discussed with E-RAU personnel to determine its fundamental components. The analyses provided the basis for the development of descriptive and judgmental scales on which each performance component, such as direction, attitude, power, and flight path, could be quickly described by the checkpilot.

B. This PPDR includes a sample of the maneuvers described in the FAA flight test guide on which proficiency must be demonstrated to pass the checkride for the Private Pilot license. This PPDR is intended to provide descriptive data for this maneuver sample only, and as such, it should be viewed as a part of the checkride and not as a substitute for the more comprehensive set of checkride maneuvers prescribed by the checkpilot. Administration of this PPDR should not restrict or constrain the checkpilot's usual checkride prerogatives. In particular, inflight safety must not be jeopardized. Although the sequence of PPDR maneuvers should be standardized as described in E.

below, it is recognized that these PPDR maneuvers will be interspersed throughout other checkride maneuvers. The performance description resulting from this PPDR is considered to be as complete as can be obtained efficiently by manual recording during a single flight period.

C. In any data collection effort, reliability (meaning consistency or repeatability of test result), and validity (meaning measurement of that which is intended to be measured) are desirable goals. One necessary factor in achieving high levels of reliability and validity is standardization of the test sample, test conditions, and methods of data recording. The standardization of the flight test sample and the methods for administering and evaluating it is the aim of the PPDR.

D. This PPDR is separated into the eight major maneuvers to be recorded. Each maneuver is divided into segments that specify observations that are to be made as objectively as possible. During a flight check, student performance normally is recorded during or near the end of each maneuver segment, provided that performance is within the limits specified as "proper" on all scales in that segment. Whenever an error exceeding "proper limits" of a scale occurs, the checkpilot should record it immediately, regardless of how much of the segment is completed. If, later in the segment, the student exceeds his previous error on the same scale, the checkpilot makes a second mark farther out on the scale. Generally speaking, erratic performance is reflected by multiple marking; for example, if the descent rate during an approach is uneven, both "slow" and "fast" may be marked.

E. There are three general levels of detail represented in the PPDR: (1) individual performance measures, (2) flight segments, and (3) maneuvers. Segments and measures are listed in the approximate sequence in which they occur during execution of the maneuver. This is intended to simplify and standardize inflight data recording.

Individual Performance Measures. The PPDR measuring scales show the detailed and descriptive criteria of student performance which underlie the evaluation made by the checkpilot. Examples of these scales are RPM, airspeed, altitude, and ground track. These scales are recorded objectively by the checkpilot from instruments or clearly definable

outside references. However, it is not always possible to find such outside references for certain crucial aspects of student performance. Consequently, a few scales are judgmental in nature, e.g., pattern exit or control smoothness. The checkpilot must use his judgment in evaluating and recording these items.

Flight Segments. The subdivision of each PPDR flight maneuver into its segments is indicated by single horizontal lines between segments. The segment breaks serve to remind the checkpilot of the time required for that particular group of measures. More importantly, they make it easier for the checkpilot to focus on a particular group of measures for the specific portion of flight performance being recorded. This reduces the difficulty in determining the flight performance sample to which each measure applies. Occasionally, a measure refers only to a specific part (beginning or end) of a segment; but these instances will be obvious to the checkpilot. Segments and measures are sequenced from the top of the page to the bottom.

Maneuvers. There are several factors about the selected flight maneuvers that the PPDR seeks to control. One factor is the specification of performance measures and segments within maneuvers. The PPDR also requires that all students perform identical maneuvers, which ensures that the same behavioral patterns are sampled in all students. Because the sequence in which maneuvers are given during a flight check can affect the results, the sequence for the eight PPDR maneuvers has been standardized. The sequence which has been settled upon should allow for maximum use of available time and resources. Due to the requirement for economy of time and effort in conducting the checkride, the maneuver performance sequence may be varied somewhat to expedite or to increase its efficiency or convenience. However, this standardized sequence should be followed as closely as possible. All maneuvers must be completed for each checkride. The recommended sequence for the eight PPDR maneuvers is:

1. Short Field Takeoff
2. Approach Stall Recovery
3. Slow Flight
4. 180° Instrument Turn

5. VOR Procedures

6. Turns About a Point

7. Traffic Pattern

8. Soft Field Landing

F. PPDR reliability is dependent upon the degree of standardization achieved in administering checkrides. It is essential that every checkpilot thoroughly understand each measure in this PPDR as described in this appendix. In addition to knowing the measure definitions, it is important that the checkpilot clearly understand that he has two roles, evaluator and recorder. In his normal role as evaluator, the checkpilot observes student performance throughout the entire checkride, and renders his assessment of the efficacy of issuing a Private Pilot license on the basis of the proficiency that he observes. As a recorder, he is asked to provide accurate and descriptive information on the observed performance as it occurs, upon which his evaluation is ultimately based. The recording function is thus extremely critical to the PPDR data collection effort. To achieve the goal of accuracy and completeness of recording, the student's performance should be recorded as soon after it occurs as is practical, with due consideration for safety.

G. The checkpilot should maintain an impartial attitude toward the student, limiting conversation to explaining checkride requirements and conditions.

H. The student pilot should not be given detailed feedback relative to checkride performance prior to debriefing.

I. Measures included in this PPDR are of two types:

1. Performance Scales with a desired range of values indicated by a triangular symbol at the scale midpoint, and errors (e.g., left/right) to either side of the triangle. For some measures a desired value is specified at the top of the triangle. Other measures include a 'O' above the triangle, indicating that the checkpilot must determine the correct desired value depending upon the aircraft, airspace, or prevailing conditions.

2. Categorical Measures (yes or no) requiring the checkpilot to determine whether or not the observed performance is within acceptable limits. This determination involves more complex judgment for some measures (e.g., constant turn radius) than others (e.g., full throttle).

J. For the scale measures that include a specified deviation range (i.e., tolerance) around the midpoint, the tolerance band specified may or may not be identical to the standards given in the FAA flight test guide. These bands are not necessarily intended to denote FAA acceptable performance, but rather to generate accurate data to document observable performance differences.

K. This version of the PPDR is not intended for use in diagnosing student performance deficiencies. However, research has shown that use of the PPDR can lead to such diagnosis by providing instructors and training managers with a valid and reliable performance data base describing typical and atypical student performance. These data may then be used as an index of comparison (norm) for any given student's observed performance, and therefore provide effective performance feedback to that student.

IV. PPDR Data Recording

A. The cover page of the PPDR is divided into three parts. Part One contains descriptive information about the student, checkpilot, aircraft, etc. and should be completed in its entirety prior to the checkride. Part Two contains weather data. The direction and velocity of crosswind as well as existing turbulence should be recorded both before and after the checkride. Part Three includes four subjective measures of pilot skill. Each measure should be slash marked with the E-RAU grade which, in the judgment of the checkpilot, best describes the overall checkride performance of the student on that factor.

B. Each scale should be marked with at least one slash mark of approximately 1/4 inch in length. The mark should pass clearly and evenly through the scale such that there is no doubt about which scale or which portion of the scale the checkpilot intended to mark. Categorical measures should include a slash mark in the appropriate box.

C. For those segments encompassing an extended period of time (e.g., climbout and pattern exit after takeoff), multiple marks will likely be necessary. This gives a record of deviations as they are observed without forcing the checkpilot to rely upon his memory of an extended performance segment. Errors observed in both directions (e.g., low <u>and</u> high) should be appropriately recorded. Short term segments (e.g., flare) should include only one mark for each measure. Requirement for multiple marking should be apparent to checkpilots.

D. If dangerous performance occurs, the checkpilot should write a letter "D" in the left margin and draw a line to the scale(s) reflecting the dangerous performance. If a maneuver is aborted because of student-induced dangerous performance, an additional notation should be made in the margin and all remaining measures on that maneuver marked in error.

E. If the checkpilot finds it necessary to assist the student with a maneuver, "CP Assist" should be noted in the margin for the affected portion of the maneuver or segment.

F. Go-arounds and their reason should be noted in the margin. When a go-around is initiated for any reason, the checkpilot shall note the go-around point on the PPDR, allow one additional approach, and begin marking at the point of go-around. If erratic student performance necessitates a second go-around, all remaining PPDR measures shall be marked in error, and PPDR recording shall terminate. If the go-arounds are, in the judgment of the checkpilot, weather or traffic-induced, a notation to that effect should be made in the margin, and remaining measures left unmarked.

G. The checkpilot should mark the appropriate E-RAU grade for <u>each</u> PPDR maneuver, and write any additional comments that he deems pertinent to the recorded performance data in the spaces provided at the bottom of each maneuver form. He may also write to the side of or directly above measures or segments, time and space permitting.

Contact PPDR

Performance Measure Definitions and Recording Guidelines

The PPDR provides a record of what actually occurs during the checkride. The maneuvers included in this PPDR are intended to be performed under normal Private Pilot checkride conditions (i.e., no more than light to moderate wind and turbulence effects). As such, the PPDR maneuvers should not be deliberately assigned under extremely windy or turbulent conditions. However, if it is necessary to administer the PPDR in such conditions, an accurate recording of the characteristics of those conditions before and after the checkride will enable them to be considered in the overall analysis of performance. The checkpilot must not allow extraneous factors to influence his marking of the actual performance scales.

Measures are of two general types. One is a scale with a triangle (△) provided at its midpoint. The triangle should be marked if performance is within non-error limits (i.e., proper). Otherwise, deviations from these limits should be marked in the appropriate error direction (e.g., low or high). Recording should not attempt to reflect the exact number of units or deviation from the midpoint (e.g., 7 kts. should be marked at any point between 5 and 10 kts.)

The other measure is categorical, requiring the checkpilot to mark either "yes" or "no" depending on whether the observed performance relative to that measure was, in his judgment, acceptable. Measure definitions should be followed in this determination.

A Grade/Comment section is included at the end of each maneuver. Here the checkpilot should enter the E-RAU grade (A, B, C, D, F) that best describes the overall quality of the maneuver performance recorded in the PPDR, and write any comments that he feels are pertinent to the performance. He may also write to the side of or directly above measures or segments, time and space permitting.

Performance Measures

Abeam Midpoint - On traffic pattern entry, mark "Yes" if entry is, within an acceptable range, made abeam the midpoint of the runway; otherwise, mark "No."

Acceptable Rotation - If rotation is acceptable, mark "Yes"; otherwise, mark "No."

Airspeed - If observed airspeed is within ±5 knots of the desired airspeed, proper should be marked; otherwise the direction and magnitude or error should be marked.

Altitude - If observed altitude is within ±50 feet of desired altitude, mark proper; otherwise, mark direction and magnitude of error.

Altitude Loss Acceptable - A measure of stall recovery skill, mark "Yes" if altitude loss during recovery is not excessive; if altitude loss is judged excessive, mark "No."

Angle (45°) - Traffic pattern entry track angle should marked "Yes" if entry is made at approximately a 45° angle; otherwise, mark "No."

Approach Angle - If the approach to landing is judged to be within approximate range of the desired approach angle, mark proper; otherwise, mark whether the angle is too "shallow" or too "steep."

Bank - When turning, if the desired bank angle is maintained within ±5°, proper should be marked; otherwise, the direction and magnitude of error should be marked.

CARB HEAT OFF - Mark "Yes" or "No" as appropriate.

Cockpit Check - If all required cockpit procedures are satisfactorily performed, mark "Yes"; otherwise mark "No."

Constant Radius Turn - A measure of wind drift correction in turns about a point, mark "Yes" if the turn radius is approximately equal throughout both turns. If the ground path is erratic or if the turns are smooth but drift corrections are improper, mark "No."

Contact - Mark proper if landing contact with the runway is correctly timed and smooth; otherwise, mark whether the aircraft was "dropped" or "bounced."

Control Coordination - A measure of general control skill, mark "Yes" if student maintains coordinated flight (±1 ball) during turn. Otherwise, mark "No."

Degrees Turned - Mark proper is the observed number of degrees turned is within ±5° of the desired number of degrees turned; otherwise, mark the direction and magnitude of error.

Descent Rate - If the observed descent rate is judged to be within approximate range of the desired descent rate, mark

proper; otherwise, mark the direction of error ("slow" or "fast").

Distance Out - Mark proper if the traffic pattern is entered at the correct distance from the runway; otherwise, indicate whether entry is "too close" or "too far" from the runway.

Enter Downwind - Mark "Yes" if entry is, within acceptable limits, in a downwind direction; otherwise, mark "No."

Flaps (10°) - Mark "Yes" or "No" as appropriate.

Full Flaps - Mark "Yes" or "No" as appropriate.

Full Throttle - If throttle is full open, mark "Yes"; any throttle setting less than full should be marked "No."

Heading - Mark proper is observed heading is within ±5° of desired heading: otherwise, mark direction and magnitude of error.

Level-off Altitude - Traffic pattern or assigned level-off altitude, if achieved within ±50 feet, should be marked proper; otherwise, the direction and magnitude of error should be marked.

Maintain Airspace Scan - If student scans (with visible head movement) for other aircraft while executing turns about a point, mark "Yes"; otherwise, mark "No."

Mixture, Full Rich - Mark "Yes" or "No" as appropriate.

Pitch Decreased - A component of stall recovery skill, mark "Yes" if pitch is properly and immediately decreased after stall occurs; otherwise, mark "No."

Power, Idle - Mark "Yes" or "No" as appropriate.

Proper Entry Sequence - If all necessary procedures are performed in the correct sequence during entry to slow flight, mark "yes", if any procedure is omitted or out of sequence, mark "No".

Proper Flaps - If the flaps are set in the desired or assigned configuration, mark "Yes"; otherwise, mark "No".

Proper Flare Attitude - Mark proper is the aircraft is in the correct nose-up pitch attitude during the flare; otherwise, mark the direction of error ("nose low" or "nose high").

Proper Ground Track - If the aircraft is maintained within an acceptable range of the desired ground track throughout a segment, mark "Yes"; otherwise, mark "No."

Proper Pattern Exit - When exiting the traffic pattern, mark "Yes" if exit is timely, at the proper location, altitude, and correct angle. If any one of these conditions is not satisfied, mark "No."

Proper Recovery Sequence - If all necessary procedures are performed in the correct sequence during recovery from slow flight, mark "Yes"; if any procedure is omitted or out of sequence, mark "No."

Radial Identified - If student can correctly identify radial and orient accordingly, mark "Yes"; otherwise, mark "No."

Reduce Power - If power is reduced within a proper time range, mark proper; otherwise, mark whether power was reduced too "early" or too "late" in the traffic pattern.

RPM - If the desired RPM setting is maintained within ±50 RPM, proper should be marked; otherwise, the direction and magnitude of error should be marked.

Runway Centerline Track - This is a measure of directional control during takeoff and landing ground roll and should be marked proper as long as the runway centerline is within the wing tips. Deviations from centerline ("left" or "right") should be marked if the wingtip opposite the direction of deviation passes the runway centerline.

Smooth Control - If control movements are judged smooth and coordinated from all segments of the maneuver, mark "Yes." If any segment contains control movements that are erratic, of excessively large magnitude or frequency, or otherwise unacceptable, mark "No."

Stall Recognized - Timely and correct recognition of stall should be marked "Yes"; otherwise, mark "No."

Station Identified - If the student can correctly identify the VOR station within an acceptable time period, mark "Yes"; otherwise, mark "No."

Station Tuned Properly - If correct VOR station is correctly tuned within an acceptable time period, mark "Yes"; otherwise, mark "No."

Track from Extended Runway - A measure of track control after liftoff and during approach to landing; proper should be marked if the aircraft track is maintained within an acceptable track

width from ground level to an altitude of 500 feet or until a turn is correctly initiated. If, in the checkpilot's judgment, proper track is not maintained during climbout or approach, "left" or "right" should be marked.

Touchdown Point - If the aircraft touches down within an acceptable range of the touchdown point, mark proper; otherwise, mark whether the observed touchdown is short or long relative to the desired or assigned touchdown point range.

Trim - A measure of ability to trim for hands-off flight, mark "Yes" if little or no control is required to maintain level flight; otherwise, mark "No."

Turn to Inbound Heading - If inbound heading is achieved within ±5° of that assigned, mark proper; otherwise, mark the direction and magnitude of error.

Turn Started - A measure of traffic pattern skill, mark proper if the turn is initiated within an acceptable distance of the desired or assigned turning point; otherwise, mark whether the turn was initiated too "early" or too "late."

VOR Track - Mark proper if the CDI needle is maintained within ± one dot of the circle for the duration of the track; otherwise, mark direction and magnitude of error.

CONTACT

Pilot Performance Description Record

1. Embry-Riddle Aeronautical University

STUDENT'S NAME	SSN
TRACK	AIRCRAFT
CHECK PILOT	DATE

2. WEATHER

BEGINNING OF FLIGHT:	END OF FLIGHT:
X WIND [L] [NONE] [R] 15° 30° 45° 60°	X WIND [L] [NONE] [R] 15° 30° 45° 60°
WIND VELOCITY (Knts) 5 10 15 20 GUSTS [NONE] [LIGHT] [MOD.]	WIND VELOCITY (Knts) 5 10 15 20 GUSTS [NONE] [LIGHT] [MOD.]

3.

FLIGHT SAFETY

[A|B|C|D|F]

SMOOTHNESS

[A|B|C|D|F]

PLANNING & JUDGMENT

[A|B|C|D|F]

COLLISION AVOIDANCE

[A|B|C|D|F]

SHORT FIELD TAKEOFF & DEPARTURE

GROUND RUN

FULL THROTTLE [NO] [YES]

RUNWAY CENTERLINE TRACK — LEFT | | RIGHT

LIFTOFF

AIRSPEED — LOW -5 55 +5 HIGH

ACCEPTABLE ROTATION [NO] [YES]

CLIMBOUT

AIRSPEED — LOW -5 +5 HIGH

TRACK FROM EXTENDED RUNWAY — LEFT | | RIGHT

BANK FOR EXIT — SHALLOW -5 +5 STEEP

PROPER PATTERN EXIT [NO] [YES]

TRIM (FOR CLIMB) [NO] [YES]

LEVEL OFF

LOW -50 +50 HIGH

TRIM (LEVEL FLIGHT) [NO] [YES]

SMOOTH CONTROL [NO] [YES]

CONTROL COORDINATION [NO] [YES]

[SLIP] [SKID]

GRADE [A] [B] [C] [D] [F] TURBULENCE [NO] [YES]

COMMENTS:

APPROACH TO LANDING STALL RECOVERY

ENTRY

PROPER ENTRY SEQUENCE	NO	YES

		-5	55	+5	
AIRSPEED	LOW				HIGH
		-5		+5	
BANK	SHALLOW				STEEP

RECOVERY

STALL RECOGNIZED	NO	YES
FULL THROTTLE	NO	YES
PITCH DECREASED	NO	YES
BANK (WINGS LEVEL)	NO	YES
CARB HEAT OFF	NO	YES
ALTITUDE LOSS ACCEPTABLE	NO	YES

SMOOTH CONTROL	NO	YES

GRADE A B C D F   TURBULENCE NO YES

COMMENTS:

SLOW FLIGHT

ENTRY

PROPER ENTRY SEQUENCE [NO] [YES]

STRAIGHT & LEVEL

AIRSPEED	-10	-5	+5	+10
ALTITUDE	-100	-50	+50	+100
HEADING	-10°	-5°	+5°	+10°

TURN

AIRSPEED	-10	-5	+5	+10
ALTITUDE	-100	-50	+50	+100

RECOVERY

PROPER RECOVERY SEQUENCE [NO] [YES]

SMOOTH CONTROL [NO] [YES]

GRADE: [A] [B] [C] [D] [F]   TURBULENCE: [NO] [YES]

COMMENTS:

180° TURN
INSTRUMENTS

BANK	-10°	-5°	+5°	+10°
ALTITUDE	-100	-50	+50	+100
AIRSPEED	-10	-5	+5	+10
DEGREES TURNED	-10°	-5°	+5°	+10°

SMOOTH CONTROL NO YES

GRADE A B C D F TURBULENCE NO YES

COMMENTS:

VOR

IDENTIFICATION

STATION TUNED PROPERLY	NO	YES
STATION IDENTIFIED	NO	YES
RADIAL IDENTIFIED	NO	YES

ALTITUDE CONTROL	-100	-50	+50	+100
HEADING CONTROL	-10°	-5°	+5°	+10°

TRACK TO STATION

TURN TO INBOUND HEADING	-10°	-5°	+5°	+10°
ALTITUDE CONTROL	-100	-50	+50	+100
AIRSPEED CONTROL	-10	-5	+5	+10

VOR TRACK ($\pm$ 1 dot)	NO	YES

GRADE A B C D F   TURBULENCE NO YES

COMMENTS:

TURNS ABOUT A POINT

ENTER DOWNWIND	NO		YES				
1st TURN				0			
ALTITUDE	-100	-50			+50	+100	
				0			
AIRSPEED	-10	-5			+5	+10	
2nd TURN							
ALTITUDE	-100	-50			+50	+100	
AIRSPEED	-10	-5			+5	+10	
CONSTANT RADIUS TURN	NO		YES				
PROPER EXIT HEADING	-10°	-5°			+5°	+10°	
MAINTAIN AIRSPACE SCAN	NO		YES				
SMOOTH CONTROL	NO		YES				

GRADE A B C D F

TURBULENCE NO YES

COMMENTS:

TRAFFIC PATTERN

ENTRY

ANGLE (45°)	NO		YES		
ABEAM MIDPOINT	NO		YES		
ALTITUDE	-100	-50		+50	+100
RPM	-100	-50		+50	+100
DISTANCE OUT	TOO CLOSE				TOO FAR

DOWNWIND

ALTITUDE	-100	-50		+50	+100
COCKPIT CHECK	NO		YES		
REDUCE POWER	EARLY				LATE
AIRSPEED	-10	-5		+5	+10
FLAPS (10°)	NO		YES		
PROPER GROUND TRACK	NO		YES		
TURN STARTED (BASE)	EARLY				LATE

TRAFFIC PATTERN

BASE

AIRSPEED	-10	-5	+5	+10
PROPER GROUND TRACK	NO	YES		
PROPER FLAPS	NO	YES		
TURN STARTED (FINAL)	EARLY			LATE
TRIM	NO	YES		

FINAL

TRACK FROM EXTENDED RUNWAY	LEFT			RIGHT
AIRSPEED	-10	-5	+5	+10
DESCENT RATE	SLOW			FAST
APPROACH ANGLE	SHALLOW			STEEP
PROPER FLAPS	NO	YES		
TRIM	NO	YES		

GRADE A B C D F

TURBULENCE NO YES

SOFT FIELD LANDING

TRANSITION (FLARE)

ALTITUDE: -10 | -5 | 20 | +5 | +10

PROPER FLARE RATE [NO] [YES]

PROPER FLARE ATTITUDE [NO] [YES]

TOUCHDOWN

TOUCHDOWN POINT: SHORT — LONG

PROPER POWER [NO] [YES]

PROPER NOSE ATTITUDE [NO] [YES]

CONTACT: DROP — BOUNCE

RUNWAY CENTERLINE TRACK: LEFT — RIGHT

SMOOTH CONTROL [NO] [YES]

GRADE [A|B|C|D|F] TURBULENCE [NO] [YES]

COMMENTS:

AD-A113 576 EMBRY-RIDDLE AERONAUTICAL UNIV DAYTONA BEACH FL F/G 5/9
THE EFFECTS OF PILOT EXPERIENCE OF ACQUIRING INSTRUMENT FLIGHT --ETC(U)
MAR 82 C W HOLMES, J M CHILDS DOT/FA79NA-6040
UNCLASSIFIED DOT/FAA/CT-82/35 NL

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APPENDIX J

PILOT PERFORMANCE DESCRIPTION RECORD (PPDR) FOR THE INSTRUMENT CHECKRIDE

This appendix presents materials for the Instrument Checkride PPDR as they were adapted for the present experiment. Three items are included. First, the Handbook, which begins on page J-2, describes the PPDR and gives instructions for its use. Second, performance measure definitions and guidelines for recording data begin on page J-8. The PPDR forms used for recording performance begin on page J-13.

Instrument Checkride Handbook

Pilot Performance Description Record (PPDR)

I. Purpose

A. General - to provide a method of clearly describing and documenting student pilot performance.

B. Specific - to provide objective performance data for evaluating instrument performance of E-RAU students.

II. Guiding Principles

A. to obtain a maximum of descriptive and specific judgmental information with a minimum of inflight marking

B. to be made compatible with existing FAA and E-RAU instrument checkride procedures

C. to provide a representative sample of student performance of those flying skills required to pass the Instrument Checkride.

III. PPDR Characteristics and General Utilization

A. Each flight maneuver in this PPDR has been analyzed and discussed with E-RAU personnel to determine its fundamental components. The analyses provided the basis for the development of descriptive and judgmental scales on which each performance component, such as direction, attitude, power, and flight path, could be quickly described by the checkpilot.

B. This PPDR includes a sample of the maneuvers described in the FAA flight test guide on which proficiency must be demonstrated to pass the checkride for the instrument rating. This PPDR is intended to provide descriptive data for this maneuver sample, and as such, should be viewed as part of the checkride. Administration of this PPDR should not restrict or constrain the checkpilot's usual checkride prerogatives. In particular, inflight safety must not be jeopardized. Although

the sequence of PPDR maneuvers should be standardized as described in E. below, it is recognized that these PPDR maneuvers will be interspersed throughout other checkride maneuvers. The performance description resulting from this PPDR is considered to be as complete as can be obtained efficiently by manual recording during a single flight period.

C. In any data collection effort, reliability (meaning consistency or repeatability of test result) and validity (meaning measurement of that which is intended to be measured) are desirable goals. One necessary factor in achieving high levels of reliability and validity is standardization of the test sample, test condition, and methods of data recording. The standardization of the flight test sample and the methods for administering and evaluating it is the aim of the PPDR.

D. This PPDR is separated into a number of instrument maneuvers to be recorded. Each maneuver is divided into segments that specify observations that are to be made as objectively as possible. During a flight check, student performance normally is recorded during or near the end of each maneuver segment, provided that performance is within the limits specified as "proper" on all scales in that segment. Whenever an error exceeding "proper limits" of a scale occurs, the checkpilot should record it immediately, regardless of how much the segment is completed. If, later in the segment, the student exceeds his previous error on the same scale, the checkpilot makes a second mark farther out on the scale. Generally speaking, erratic performance is reflected by multiple marking; for example if the descent rate during an approach is uneven, both "slow" and "fast" may be marked.

E. There are three general levels of detail represented in the PPDR: (1) individual performance measures, (2) flight segments, and (3) maneuvers. Segments and measures are listed in the approximate sequence in which they occur during execution of the maneuver. This is intended to simplify and standardize inflight data recording.

Individual Performance Measures. The PPDR measuring scales show the detailed and descriptive criteria of student performance which underlie the evaluation made by the checkpilot. Examples of these scales are airspeed, altitude and ground

track. These scales are recorded objectively by the checkpilot from instruments or clearly definable outside references. However, it is not always possible to find such outside references for certain crucial aspects of student performance. Consequently, a few scales are judgmental in nature, e.g., control smoothness. The checkpilot must use his judgment in evaluating and recording these items.

Flight Segments. The subdivision of each PPDR flight maneuver into its segments is indicated by single horizontal lines between segments. The segment breaks serve to remind the checkpilot of the time required for that particular group of measures. More importantly, they make it easier for the checkpilot to focus on a particular group of measures for the specific portion of flight performance being recorded. This reduces the difficulty in determining the flight performance sample to which each measure applies. Occasionally, a measure refers only to a specific part (beginning or end) of a segment, but these instances will be obvious to the checkpilot.

Segments and measures are sequenced from top of page to the bottom.

Maneuvers. There are several factors about the selected flight maneuvers that the PPDR seeks to control. One factor is the specification of performance measures and segments within maneuvers. The PPDR also requires that all students perform identical maneuvers, which ensures that the same behavioral patterns are sampled in all students. Because the sequence in which maneuvers are given during a flight check can affect the results, the sequence for the PPDR maneuvers is standardized. The sequence settled upon should allow for maximum use of available time and resources. Due to the requirement for economy of time and effort in conducting the checkride, the performance sequence of certain maneuvers may be varied to expedite or to increase its efficiency or convenience. However, the standardized sequence should be followed as closely as possible. All maneuvers must be completed for each checkride.

F. PPDR reliability is dependent upon the degree of standardization achieved in administering the instrument checkrides. It is essential that every checkpilot thoroughly understand each measure in

this PPDR as described in this appendix. In addition to knowing the measure definition, it is important that the checkpilot clearly understand that he has two roles, evaluator and recorder. In his normal role as evaluator, the checkpilot observes student performance throughout the entire checkride, and renders his assessment of the advisability of issuing the instrument rating on the basis of the proficiency that he observes. As a recorder, he is asked to provide accurate and descriptive information on the observed performance <u>as it occurs</u>, upon which his evaluation is ultimately based. The recording function is thus extremely critical to the PPDR data collection effort. To achieve the goal of accuracy and completeness of recording, the student's performance should be recorded as soon as possible, with due consideration for safety.

G. The checkpilot should maintain an impartial attitude toward the student, limiting conversation to explaining checkride requirements and conditions.

H. The student pilot should not be given detailed feedback relative to checkride performance prior to debriefing.

I. Measures included in this PPDR are of two types:

   1. <u>Performance Scales</u> with a desired range of values indicated by a triangular symbol at the scale midpoint, and errors (e.g., left/right) to either side of the triangle. For some measures, a desired value is specified at the top of the triangle. Other measures do not specify a desired value, indicating that the checkpilot must determine the correct desired value depending upon the aircraft, airspace, or prevailing conditions.

   2. <u>Categorical Measures</u> (yes or no) requiring the checkpilots to determine whether or not the observed performance is within acceptable limits. This determination involves more complex judgment for some measures (e.g., compliance with ATC instructions) than others (e.g., report).

J. For the scale measures that include a specified deviation range (i.e., tolerance) around the midpoint, the tolerance band specified may or may

not be identical to the standards given in the FAA flight test guide. These bands are not necessarily intended to denote FAA acceptable performance, but rather to generate accurate data to document observable performance differences.

K. This version of the PPDR is not intended for use in diagnosing student performance deficiencies. However, research has shown that use of the PPDR can lead to such diagnosis by providing instructors and training managers with a valid and reliable performance data base describing typical and atypical student performance. These data may than be used as an index of comparison (norm) for any given student's observed performance, and therefore, provide effective performance feedback to the student.

IV. PPDR Data Recording

A. The cover page of the PPDR is divided into three parts. Part One contains descriptive information about the student, checkpilots, aircraft, etc. and should be completed in its entirety prior to the checkride. Part Two contains weather data. The appropriate conditions (IFR or VFR) as well as existing wind speed and gust should be recorded both before <u>and</u> after the checkride. Part Three includes four subjective measures of pilot skill. Each measure should be slash marked with the E-RAU grade which, in the judgment of the checkpilot, best describes the overall checkride performance of the student on that factor.

B. Each scale should be marked with at least one slash mark of approximately 1/4 inch in length. The mark should pass clearly and evenly through the scale such that there is not doubt about which scale or which portion of the scale the checkpilot intended to mark. Categorical measures should include a slash mark in the appropriate box.

C. For those segments encompassing an extended period of time (e.g., bank in a turn) multiple marks may be necessary. This gives a record of deviations as they are observed without forcing the checkpilot to rely upon his memory of an extended performance segment. Errors observed in both directions (e.g., low <u>and</u> high) should be appropriately recorded. Short term segments (e.g., VOR station passage) should include only one mark for each measure.

Requirement for multiple marking should be apparent to checkpilots.

D. If dangerous performance occurs, the checkpilot should write a letter "D" in the left margin and draw a line to the scale(s) reflecting the dangerous performance. If a maneuver is aborted because of student-induced dangerous performance, an additional notation should be made in the margin and all remaining measures on that maneuver marked in error.

E. If the checkpilot finds it necessary to assist the student with a maneuver, "CP Assist" should be noted in the margin for the affected portion of the maneuver or segment.

F. The checkpilot should mark the appropriate E-RAU grade for each PPDR maneuver, and write any additional comments that he deems pertinent to the recorded performance data in the spaces provided at the bottom of each maneuver form. He may also write to the side of, or directly above measures or segments, time and space permitting.

G. Data recording for each PPDR maneuver should be complete. If certain measures are not marked, the reason for the incomplete form should be noted.

Instrument PPDR

Performance Measure Definitions and Recording Guidelines

The PPDR provides a record of what actually occurs during the checkride. The maneuvers included in this PPDR are intended to be performed under favorable checkride conditions (i.e., no more than light to moderate wind and turbulence effects). As such, the PPDR maneuvers should not be deliberately assigned under extremely windy or turbulent conditions. However, if it is necessary to administer the PPDR in such conditions, an accurate recording of the characteristics of those conditions before and after the checkride will enable them to be considered in the overall analysis of performance. The checkpilot must not allow extraneous factors to influence his marking of the actual performance scales.

Measures are of two general types. One is a scale with a triangle (△) provided at midpoint. The triangle should be marked if performance is within non-error limits (i.e.) proper). Otherwise, deviations from these limits should be marked in the appropriate error direction (e.g., low or high). Recording should not attempt to reflect the exact number of units of deviation from the midpoint (e.g., both 6 Kts and 9 Kts should be marked midway between 5 and 10 Kts.)

The other measure is categorical, requiring the checkpilot to mark either "yes" or "no" depending on whether the observed performance relative to the measure was, in his judgment, acceptable. Measure definitions should be followed in this determination.

A Grade/Comment section is included at the end of each maneuver. Here the checkpilot should enter the E-RAU grade (A, B, C, D, F) that best describes the overall quality of the maneuver performance recorded in the PPDR, and write any comments that he feels are pertinent to the performance. He may also write to the side of, or directly above measures or segments, time and space permitting.

Performance Measures

Aircraft Control - Mark "Yes" if confident and accurate control of the aircraft takes priority at MAP; if preoccupation with other tasks or hesitation occurs, mark "No".

Aircraft Performance Data - Mark "Yes" is flight manual information can be accurately applied to the aircraft's

performance characteristics and capabilities; otherwise, mark "No".

Airspeed - If observed airspeed is within ±5 knots of the desired airspeed, proper should be marked; otherwise the direction and magnitude of error should be marked.

Altitude - If observed altitude is within ±50 feet of desired altitude, mark proper; otherwise, the direction and magnitude or error should be marked.

Assigned Airspeeds Attained - Mark "Yes" if all assigned airspeeds are attained within +2 knots; otherwise, mark "No".

Avionics - Mark "Yes" if student can demonstrate the skillful use of radio communications procedures for report, ATC clearances, or other functions; otherwise mark "No".

Bank - When turning, if the desired bank angle is maintained with ±5°, proper should be marked; otherwise, the direction and magnitude of error should be marked.

CDI Needle Centered - Mark "Yes" if the CDI needle remains within the doughnut during orientation otherwise, mark "No".

Clearance - Mark "Yes" if student can correctly obtain necessary ATC clearance prior to takeoff; otherwise, mark "No".

Compliance with All ATC Instructions - Mark "Yes" if student understands and correctly responds to all ATC instructions; otherwise, mark "No".

Compliance with Part 91 and AIM Procedures - Mark "Yes" or "No" as appropriate.

Control Coordination - A measure of general control skill, mark "Yes" if student maintains coordinated flight (± 1 ball) during turn; otherwise, mark "No".

Correct and Timely Control Movements - If control inputs are both correct and timely in recovering from the unusal attitude, mark "Yes"; if hesitation or improper inputs are observed, mark "No".

Course Tracking (±2°) - Mark "Yes" if track is maintained with ±2° of desired course; otherwise, mark "No".

Degrees Turned - Mark proper of the observed number of degrees turned is within ±5° of the desired number of degrees turned, otherwise, mark the direction and magnitude of error.

ETA - Mark "Yes" if student's ETA is within ±5 minutes of actual arrival; otherwise, mark "No".

Flight Log - Mark "Yes" if flight log contains all information (e.g., enroute courses, fuel requirements, estimated ground speeds, ETE's) pertinent to selected route; otherwise, mark "No".

Glide Slope - (±1 dot) - Mark "Yes" if glide slope is maintained within ±1 dot of doughnut; otherwise, mark "No".

Initial Altitude Recovered - Mark "Yes" or "No" as appropriate.

Initial Heading Recovered - Mark "Yes" or "No" as appropriate.

Instruments and Equipment - Mark "Yes" if student can thoroughly and accurately perform operation checks of engine instruments, flight instruments, and avionics; otherwise, mark "No".

MDA - If observed altitude on final approach remains within, but not below 100 feet of the published MDA, mark "Yes"; otherwise, mark "No".

Pitch/Power Coordination - Mark "Yes" if aircraft pitch is properly controlled when applying power for airspeed change; otherwise, mark "No".

Procedures - Mark "Yes" if all required procedures are performed in an accurate and timely manner; otherwise, mark "No".

Proper Entry - If all necessary procedures are performed in the correct sequence during entry to a segment, mark "Yes"; if any procedure is omitted or out of sequence, mark "No".

Proper Judgment - Mark "Yes" if student exhibits proper judgment in view of the situation or emergency; otherwise, mark "No".

Proper Lead/Lag - Mark "Yes" if rollout on mag compass turn reflects the correct lead or lag (±5°) for the assigned heading; otherwise, mark "No".

Proper Power Change - Mark "Yes" if the power change, within acceptable limits, is that necessary to effect the desired airspeed change; otherwise, mark "No".

Proper Sequence - Mark "Yes" if recovery sequence is correct; otherwise, mark "No".

Proper Setup - If all assigned flight variables are within their desired range or condition upon initiating the maneuver, mark "Yes"; otherwise, mark "No".

Proper Timing - Mark "Yes" if timing for all legs of a holding pattern is within desired limits; otherwise, mark "No".

Proper Turn - Mark "Yes" if the turn is initiated and terminated at the proper time, and executed at the proper rate; otherwise, mark "No".

Radio Calls - Mark "Yes" if student demonstrates all necessary radio communications prior to takeoff; otherwise, mark "No".

Recognition of Attitude - If student recognized aircraft attitude upon taking the controls, mark "Yes"; if control movements indicate that the aircraft attitude has not been recognized, mark "No".

Report - Mark "Yes" if student gives accurate and timely report of position and intention to ATC; if student forgets to report or gives incorrect information, mark "No".

Reset DG - Mark "Yes" if directional gyro is reset accurately prior to tuning a station; otherwise mark "No".

Rolled Out on Course - Mark "Yes" if turn is terminated within 5° of the desired course; otherwise, mark "No".

Route Selection - Mark "Yes" if cross-country route selected is acceptable; otherwise, mark "No".

Smooth Control - If control movements are judged smooth and coordinated for all segments of a maneuver, mark "Yes". If any segment contains control movements that are erratic, of excessively large magnitude or frequency, or otherwise unacceptable, mark "No".

Station Tuned, Identified - Mark "Yes" or "No" as appropriate.

Timely and Accurate Response to Emergency - Mark "Yes" or "No" as appropriate.

Timely Compliance with All Procedures - Mark "Yes" if all missed approach procedures are followed without hesitation; otherwise, mark "No".

Track (ILS, ADF) - Mark "Yes" if heading remains within ±2° of course to the station during the entire segment; otherwise, mark "No".

Track (VOR) - Mark "Yes" if the needle remains within the doughnut during the entire segment; otherwise, mark "No".

Transponder - Mark "Yes" if student can correctly tune the assigned transponder frequency prior to takeoff, otherwise, mark "No".

Vertical Speed - Mark "Yes" if observed vertical speed is within ±50 fpm of desired vertical speed in a climb or descent; otherwise, mark "No".

Weather Information - Mark "Yes" if all weather information pertinent to the selected route is obtained and analyzed; otherwise, mark "No".

Instrument Checkride

Pilot Performance Description Record

Embry-Riddle Aeronautical University

1.

STUDENT'S NAME	SSN
TRACK	AIRCRAFT
CHECK PILOT	DATE

2. WEATHER

BEGINNING OF FLIGHT:	END OF FLIGHT:
IFR VFR	IFR VFR
WIND VELOCITY (Knts) 5 10 15 20	WIND VELOCITY (Knts) 5 10 15 20
GUSTS NONE LIGHT MOD.	GUSTS NONE LIGHT MOD.

3.

FLIGHT SAFETY

A B C D F

SMOOTHNESS

A B C D F

PLANNING & JUDGMENT

A B C D F

COMMUNICATIONS PROCEDURES

A B C D F

STRAIGHT AND LEVEL (60 secs)

SETUP

PROPER SETUP [NO] [YES]

EXECUTION

HEADING -10° -5° +5° +10°

AIRSPEED -10 -5 +5 +10

ALTITUDE -100 -50 +50 +100

GRADE [A] [B] [C] [D] [F] TURBULENCE [NO] [YES]

COMMENTS:

MAGNETIC COMPASS TURN

SETUP

PROPER SETUP [NO] [YES]

ROLLIN

BANK	-10°	-5°	+5°	+10°
ALTITUDE	-100	-50	+50	+100

MAINTAIN

BANK	-10°	-5°	+5°	+10°
ALTITUDE	-100	-50	+50	+100

ROLLOUT

ALTITUDE	-100	-50	+50	+100
DEGREES TURNED	-10°	-5°	+5°	+10°

PROPER LEAD/LAG [NO] [YES]

SMOOTH CONTROL [NO] [YES]

GRADE [A] [B] [C] [D] [F] TURBULENCE [NO] [YES]

COMMENTS:

SLOW FLIGHT

ENTRY

PROPER ENTRY SEQUENCE [NO] [YES]

STRAIGHT AND LEVEL

AIRSPEED	-10	-5	+5	+10
ALTITUDE	-100	-50	+50	+100
HEADING	-10°	-5°	+5°	+10°

TURN

AIRSPEED	-10	-5	+5	+10
ALTITUDE	-100	-50	+50	+100

RECOVERY

PROPER SEQUENCE [NO] [YES]

SMOOTH CONTROL [NO] [YES]

GRADE [A|B|C|D|F] TURBULENCE [NO] [YES]

COMMENTS:

VOR

ORIENTATION

RESET DG	NO	YES
STATION TUNED, IDENTIFIED	NO	YES
CDI NEEDLE CENTERED	NO	YES

ASSIGNED ALTITUDE	-100	-50	+50	+100
ASSIGNED HEADING	-10°	-5°	+5°	+10°

APPROACH

ROLLED OUT ON COURSE(±5°)	NO	YES
TRACK	NO	YES
MDA (+100ft)	NO	YES

AIRSPEED	-10	-5	+5	+10

MISSED APPROACH

TIMELY COMPLIANCE WITH ALL PROCEDURES	NO	YES
REPORT	NO	YES
AIRCRAFT CONTROL	NO	YES

COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES

GRADE A B C D F TURBULENCE NO YES

COMMENTS:

ADF APPROACH

RESET DG	NO	YES
STATION TUNED, IDENTIFIED	NO	YES
COURSE INTERCEPTED (±10°)	NO	YES
ROLLED OUT ON COURSE(±5°)	NO	YES
PROPER TRACK	NO	YES
WIND CORRECTION	NO	YES
MDA	NO	YES

AIRSPEED

MISSED APPROACH

TIMELY COMPLIANCE WITH ALL PROCEDURES	NO	YES
REPORT	NO	YES
AIRCRAFT CONTROL	NO	YES

COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES

GRADE A B C D F   TURBULENCE NO YES

COMMENTS:

ILS APPROACH

TRACKING TO OM

STATION TUNED, IDENTIFIED	NO		YES	
COURSE INTERCEPTED	NO		YES	
ROLLED OUT ON COURSE (±5°)	NO		YES	
PROPER TRACK	NO		YES	
ALTITUDE	-100	-50	+50	+100
GLIDESLOPE INTERCEPTED (± 1 dot)	NO		YES	

APPROACH

ALTITUDE	-100	-50	+50	+100
REPORT	NO		YES	
AIRSPEED	-10	-5	+5	+10
COURSE TRACKING (±2°)	NO		YES	
GLIDE SLOPE (± 1 Dot)	NO		YES	
PROPER TIME	NO		YES	
ALTITUDE-OM (+100FT)	NO		YES	

ILS

MISSED APPROACH (if applicable)

TIMELY COMPLIANCE WITH ALL PROCEDURES	NO	YES
REPORT	NO	YES
COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES
AIRCRAFT CONTROL	NO	YES

GRADE A B C D F   TURBULENCE NO YES

COMMENTS:

HOLDING

VOR   ADF   OTHER

PROPER ENTRY	NO	YES		
TRACK	NO	YES		
PROPER TIMING	NO	YES		
PROPER TURN RATE	NO	YES		
ALTITUDE	-100	-50	+50	+100
AIRSPEED	-10	-5	+5	+10
COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES		

GRADE A B C D F   TURBULENCE NO YES

COMMENTS:

PROCEDURE TURN [VOR] [ADF] [OTHER]

PROPER TURN	NO	YES
TRACK	NO	YES
PROPER TIMING	NO	YES
ALTITUDE	-100	-50 +50 +100
AIRSPEED	-10	-5 +5 +10
COMPLIANCE WITH ALL ATC INSTRUCTIONS	NO	YES

GRADE [A|B|C|D|F] TURBULENCE [NO] [YES]

COMMENTS:

CROSS COUNTRY (ORAL)

ROUTE SELECTION	NO	YES
WEATHER INFORMATION	NO	YES
FLIGHT LOG	NO	YES
AIRCRAFT PERFORMANCE DATA	NO	YES
INSTRUMENTS & EQUIPMENT	NO	YES
AVIONICS	NO	YES
ENROUTE PROCEDURES	NO	YES
TERMINAL PROCEDURES	NO	YES
PROPER JUDGMENT	NO	YES

GRADE [A|B|C|D|F]

COMMENTS:

RADAR VECTOR [NO] [YES] [OTHER]

COMPLIANCE WITH ALL ATC INSTRUCTIONS AND IFR PROCEDURES [NO] [YES]

HEADING -10° -5° +5° +10°

ALTITUDE -100 -50 +50 +100

GRADE [A|B|C|D|F] TURBULENCE [NO] [YES]

COMMENTS:

EMERGENCY PROCEDURE - LOSS OF RADIO COMMUNICATIONS

TIMELY AND ACCURATE RESPONSE TO EMERGENCY [NO] [YES]

COMPLIANCE WITH PART 91 AND AIM PROCEDURES [NO] [YES]

MAINTAIN ALTITUDE ($\pm$100ft) [NO] [YES]

MAINTAIN HEADING ($\pm$10°) OR TURN RATE ($\pm$1°sec) [NO] [YES]

PROPER JUDGMENT [NO] [YES]

GRADE [A|B|C|D|F] TURBULENCE [NO] [YES]

COMMENTS:

APPENDIX K

DAILY PROGRESS RECORD (DPR) FOR INSTRUMENT TRAINING

This appendix presents materials for the DPR that was used to record performance during instrument training. Three items are included. First, the User's Guide, which begins on page K-2, describes the DPR and gives instructions for its use. Second, the performance measures to be included, and specific instructions for recording them, begin on page K-5. Third, the DPR forms used for recording performance begin on page K-8.

User's Guide

Daily Progress Record (DPR)

Instrument Maneuvers

I. Purpose

A. The purpose of the DPR is to record and document the attainment of various specified performance criteria for E-RAU instrument maneuvers and procedures.

B. This documentation will result in objective performance data to be used in the assessment of Instrument proficiency of those E-RAU students receiving three different amounts of Contact training.

II. Principles

The DPR is intended

A. to provide a descriptive profile of performance occurring across training days without requiring excessive "head-in-cockpit" recording time by instructors;

B. to be made compatible with the Instrument PPDR used for recording checkride performance;

C. to provide a means of depicting the rate of change in instrument flying skill over training time.

III. Characteristics

A. The maneuvers and procedures included in this DPR are representative of those described in the FAA Instrument Test Guide on which E-RAU students must demonstrate proficiency to obtain the instrument rating. Each maneuver has been analyzed with respect to what must be accomplished to result in its successful performance. These performance requirements are related to aircraft state and may be observed and recorded in a relatively objective manner.

B. Use of this DPR should not restrict or otherwise interfere with instruction. The DPR is a research tool intended for performance measurement purposes only. Instructors should employ their usual instructional techniques.

C. Inflight safety must, of course, take precedence over all other training activities including both instruction and data recording.

D. The DPR maneuvers will likely be interspersed throughout other instrument maneuvers. DPR data recording should, therefore, be a part of, rather than an addition to, each daily training session.

IV. Format

A. The first page of the DPR booklet contains descriptive information concerning the student and instructor. It should be completed prior to beginning DPR data recording. Each student will have a separate DPR booklet which will be used by the instructor to record that student's data throughout instrument training.

B. The DPR consists of <u>maneuvers</u> (e.g., Turns) which are subdivided into a number of <u>segments</u> (e.g., Roll-in) and <u>measures</u> (e.g., Altitude). Each measure includes either a qualitative definition or quantitative tolerance level. Qualitative definitions are given in the appendix of this guide. Quantitative tolerance levels are specified beside the appropriate measures in the DPR. An example of a measure for which a qualitative definition is required is "Proper Setup." Quantitative tolerance levels are specified for such measures as "Altitude" (±50 ft) and "Airspeed" (±5 kts). Measures such as Heading and Altitude commonly are used more than once for most DPR maneuvers.

V. Data Recording

A. In marking the DPR, the instructor must ascertain, <u>solely on the basis of the specified definition or tolerance level for each measure</u>, whether the observed performance satisfies the definition or tolerance level for that measure. If the measure is determined to be within acceptable limits, a check (✓) is marked in the box adjacent to the measure. If the measure is not within limits, an X should be marked in the box. No allowances should

be made for extraneous factors (e.g., amount of training) in making this determination. <u>End-of-phase standards should, without exception, be used for assessing all maneuvers and measures</u>.

B. Data should be recorded from the top to bottom in each column although columns are broken according to segment. The top box in each column should include a different training date (i.e., data recording for a given DPR maneuver should occur no more than once for a given training day). Further, for data for any DPR maneuver should be recorded for the <u>first</u> execution of the maneuver on any given day. This provides some control for practice effects and hence, increases the validity of DPR data.

C. Recording for DPR maneuvers should be <u>complete</u> (i.e., if the first measure of any column contains a mark, all measures of that column must contain a mark). If, for some reason, it is not possible to record data for the entire maneuver, reasons for the incomplete recording should be noted on the DPR form.

D. With due consideration for inflight safety, all measures should be recorded as they occur during the execution of the DPR maneuver. If it is not possible to mark the DPR maneuver, as it is being performed, this should be done as soon after the observed performances as possible. This decreases reliance on memory, and increases data validity.

E. A sample of a correctly recorded DPR maneuver is shown below.

<u>STRAIGHT & LEVEL (60 secs)</u>

Date	1/3	1/4	1/7	1/8	1/11	1/12	1/13	1/14		
<u>Setup</u>										
Proper Setup	X	X	X	X	✓	X	X	✓		
<u>Execution</u>										
HDG (±5°)	✓	✓	X	X	✓	X	✓	✓		
A/S (±5kts)	X	X	X	✓	✓	X	X	✓		
ALT (±50ft)	X	✓	X	✓	✓	✓	✓	✓		

Instrument DPR

DPR Performance Measure Definitions and Recording Guidelines

Aircraft Control - Insert checkmark if confident and accurate control of the aircraft takes priority during a missed approach; if preoccupation with other tasks or hesitation occurs, mark X.

Aircraft Performance Data - Insert checkmark if flight manual information can be accurately applied to the aircraft's performance characteristics and capabilities; otherwise, mark X.

All A/S Attained - Insert checkmark if all assigned airspeeds are attained with ±2 knots; otherwise, mark X.

Centered Needle - Insert checkmark if the CDI needle remains within the doughnut during orientation; otherwise, mark X.

Clearance - Insert checkmark if student can correctly obtain necessary ATC clearance prior to takeoff; otherwise, mark X.

Compliance with All ATC Instructions - Insert checkmark if student understands and correctly responds to all ATC instructions. Otherwise, mark X.

Compliance with All Procedures - Insert checkmark if student complies (timely and accurately) with all missed approach procedures; otherwise, mark X.

Compliance with Part 91 and AIM Procedures - Insert checkmark or X as appropriate.

Coordination - A measure of general control skill, insert checkmark if student maintains coordinated flight (±ball) during turn. Otherwise, mark X.

Correct Number of Degrees Turned (±5) - Insert checkmark if actual number of degrees turned is within 5° of desired number of degrees for the amount of time in the turn; otherwise, mark X.

Correct and Timely Control Movements - If control inputs are both correct and timely in recovering from the unusual attitude, insert checkmark; if hesitation or improper inputs are observed, mark X.

Course Tracking (±2°) - Insert checkmark if track is maintained within ±2° of desired course; otherwise, mark X.

Flight Log - Insert checkmark if flight log contains all information (e.g., enroute courses, fuel requirements, estimated ground speeds, ETE's) pertinent to selected route; otherwise, mark X.

Glide Slope (±1 dot) - Insert checkmark if glide slope is maintained within ±1 dot of doughnut; otherwise, mark X.

Instruments and Equipment - Insert checkmark if student can thoroughly and accurately perform operation checks of engine instruments, flight instruments, and avionics; otherwise, mark X.

Procedures - Insert checkmark if all required procedures are performed in an accurate and timely manner; otherwise, mark X.

Position Established - Insert checkmark if student correctly establishes position relative to station or desired course; otherwise, mark X.

Proper Entry - If all necessary procedures are performed in the correct sequence during entry to a segment, insert checkmark; if any procedure is omitted or out of sequence, mark X.

Proper Judgment - Insert checkmark if student exhibits proper judgment in view of the situation or emergency; otherwise, mark X.

Proper Power Change - Insert checkmark if the power change, within acceptable limits, is that necessary to effect the desired airspeed change; otherwise, mark X.

Proper Setup - If all assigned flight variables are within their desired range or condition upon initiating the maneuver, insert checkmark; otherwise, mark X.

Proper Timing - Insert checkmark if timing for all legs of a procedure turn, holding pattern, or approach is within desired limits; otherwise, mark X.

Proper Track (ILS, ADF) - Insert checkmark if heading remains within ±2° of course to the station during the entire segment; otherwise mark X.

Proper Track (VOR) - Insert checkmark if the needle remains within the doughnut during the entire segment; otherwise, mark X.

Proper Turn - Insert checkmark if the turn is initiated and terminated at the proper time, and executed at the proper rate; otherwise, mark X.

Radio Calls - Insert checkmark if student demonstrates all necessary radio communications prior to takeoff; otherwise, mark X.

Recognition of Attitude - If student recognizes aircraft attitude upon taking the controls, insert checkmark; if control movements indicate that the aircraft attitude has not been recognized, mark X.

Report - Insert checkmark if student gives accurate and timely report of position and intention to ATC; if student forgets to report or gives incorrect information, mark X.

Reset DG - Insert checkmark if directional gyro is reset accurately prior to tuning a station; otherwise, mark X.

INSTRUMENT

DAILY PROGRESS RECORD (DPR)

EMBRY - RIDDLE AERONAUTICAL UNIVERSITY

STUDENT
SSN
TRACK
INSTRUCTOR

STRAIGHT AND LEVEL (60 secs)

Date										
ALT (±50 ft)										
A/S (±5 kts)										
HDG (±5°)										
Smooth Control										

Airspeed Change

Date										

SETUP

Proper Setup										

POWER CHANGE

Proper Power Change										
ALT (±50ft)										
HDG(±5°)										

All A/S Attained (±5 Kts)										
Smooth Control										

180°
TURN

Date										
Proper Setup										
ROLLIN										
Proper Bank($\pm$5°)										
ALT ($\pm$50ft)										
MAINTAIN										
Proper Bank($\pm$5°)										
ALT ($\pm$50ft)										
Coordination										
ROLLOUT										
ALT ($\pm$50ft)										
180°($\pm$5°) turned										
Smooth Control										

CLIMB/DESCENT

1 ☐ Constant A/S   2 ☐ Constant Rate

Date										
Proper Setup										
INITIATE										
Proper Power Change										
A/S($\pm$5kts)										
HDG($\pm$5°)										
MAINTAIN										
VS($\pm$50fpm)										
A/S($\pm$5kts)										
HDG($\pm$5°)										
LEVELOFF										
ALT($\pm$50ft)										
A/S($\pm$5kts)										
HDG($\pm$5°)										
Smooth Control										

VOR

Date										

ORIENTATION

Reset DG										
Station Tuned & Identified										
Centered needle										
ALT(±50ft)										
HDG(±5°)										

APPROACH

Roll Out on Course (±5°)										
TRACK (±1 dot)										
MDA(+100ft)										
A/S(±5kts)										

MISSED APPROACH

Report										
Compliance with all procedures										
Aircraft control										

Compliance with ATC procedures										

ADF APPROACH

Date										

APPROACH

Reset DG										
Station Tuned & Identified										
Course Intercepted (±10°)										
Roll Out on Course(±5°)										
Proper Track										
Wind Correction										
MDA (+50ft)										
A/S (±5kts)										

MISSED APPROACH

Compliance with all procedures										
Report										
Aircraft Control										

Compliance with ATC instructions										

ILS APPROACH

Date										

TRACKING TO OM

Station Tuned & Identified										
Course Intercepted (±10°)										
Roll Out on Course(±5°)										
Proper Track										
ALT (±50ft)										
Glideslope Intercepted (±1 dot)										

APPROACH

ALT(±50ft)										
A/S(±5kts)										
Report										
Course Tracking (±1 dot)										
Glideslope (±1 dot)										
ALT-DH (+100ft)										

ILS APPROACH

MISSED APPROACH

Compliance with all procedures										
Report										
Aircraft Control										

Compliance with ATC instructions										

HOLDING

1 VOR | 2 ADF | 3 OTHER

Date										

Proper Entry										
Proper Track										
Proper Timing										
Proper Turn Rate										
ALT ($\pm$50ft)										
A/S ($\pm$5kts)										
Compliance with ATC instructions										

PROCEDURE TURN

1 VOR | 2 ADF | 3 OTHER

Date										

Proper Track										
Proper Timing										
Proper Turn										
ALT ($\pm$50ft)										
A/S($\pm$5kts)										
Compliance with ATC instructions										

CROSS COUNTRY

Date										

Route Selection										
Weather Information										
Flight Log										
Aircraft Performance Data										
Instruments & Equipment										
Enroute Procedures										
Terminal Procedures										
Proper Judgment										

EMERGENCY PROCEDURES

Date										

LOSS OF RADIO COMMUNICATION

Compliance with all ATC instructions										
Compliance with Part 91 and AIM Procedures										
ALT($\pm$100ft)										
HDG($\pm$10°) or Turn Rate ($\pm$1°/sec)										
Proper Judgment										

EQUIPMENT/INSTRUMENT MALFUNCTION

Compliance with all ATC instructions										
ALT($\pm$100ft)										
HDG($\pm$10°) or Turn Rate ($\pm$1°/sec)										
Proper Judgment										

UNUSUAL ATTITUDE RECOVERIES

Date										

RECOGNITION

Recognition of Attitude										

RECOVERY

Correct Control Movements										
Initial ALT recovered (±100ft)										
HDG control										
Smooth Control										

ILMED

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